COMMITTEE WORKSHOP

BEFORE THE

CALIFORNIA ENERGY RESOURCES CONSERVATION

AND DEVELOPMENT COMMISSION

In the Matter of:	)	
	)	
INTEGRATED ENERGY POLICY	)	Docket No.
REPORT WORKSHOP	)	02-IEP-01
	)	

CALIFORNIA ENERGY COMMISSION

HEARING ROOM A

1516 NINTH STREET

SACRAMENTO, CALIFORNIA

THURSDAY, JUNE 5, 2003

Reported by:
Alan Meade
Contract No. 150-01-005

COMMISSIONERS PRESENT

James Boyd, Presiding Member

William J. Keese, Associate Member

STAFF PRESENT

Jim McKinney

Al Alvarado

OTHERS PRESENT

Randy Livingston

Jim Woodward

Pam Taheri

Mary Jo Thomas

Karen Griffin

Maurice Roos

Jim Canaday

Ted Frink

Nancee Murray

Richard McCann

John Kessler

Dave Moller

Annie Manji

Eric Theiss

Joe O'Hagan

OTHERS PRESENT (CONT)

Michael Kane

Guido Franco

Pierre du Vair

Steve Wald

Richard Roos-Collins

Mark Anderson

Lon House

Steve Rothert

I N D E X

P R O C E E D I N G S

9:40 a.m.

PRESIDING MEMBER BOYD: I'll say good morning again now that we're on the record. Welcome to another in a series of Integrated Energy Policy Report Workshops. In this case it may be the first state sponsored workshop on hydroelectricity and environmental quality.

A little bit of a new and different topic, but one that's very relevant to our responsibilities as California's Energy Information Agency, we do have responsibility to provide energy information to the public, the legislature and the Governor.

And there's a lot about hydroelectricity that a lot of people don't understand. This agency's knowledge of hydroenergy values, it's role in meeting state level reliability and cost goals, and its environmental effects is relatively basic. And we need to know more in order to fill our responsibilities for this Integrated Policy Report.

Therefore, our goal today is to increase our collective knowledge by having this public discussion on hydropower. We brought together experts to present and share their views. We're going to hear presentations from our own staff, from hydropower producers, from government agencies, environmental agencies, and conservation organizations, and the public at large.

We want to learn and to understand more about this important energy resource that's effect on our environment and opportunities to improve the energy environment balance in our state. We're sponsoring this workshop principally through our authority under the legislation that created the Integrated Energy Police Report.

Of course our basic responsibilities were first established in the Warren Alquist Act that provides basic responsibilities for energy activities, supplies, energy use, cost, effects on public health and the environment.

We need to identify issues, and then we have a responsibility to develop policy recommendations to our Governor and the legislature in accordance with the legislation calling for the Integrated Energy Policy Report. Historically, the Commission has not had authority on hydropower licensing or operations.

This is pretty heavily reserved to the

Federal Energy Regulatory Commission. However, the state agencies like the Water Resources Control Board and the Department of Fish and Game have environmental regulatory authorities, as do numerous federal agencies that we, the state, and this agency have been involved in over the years.

We do have the authority and responsibility to identify issues in the use and supply of energy in California and, therefore, we need the hydropower component added to our list of subject areas.

There are very seasonal operations associated with hydropower that have very important ramifications for, and implications on, not only California and California's environment, but the rest of the western electricity grid. And it affects generation and natural gas systems, demands, and we have to work into the equations of understanding our energy background.

And then there a host of controversial issues that are associated with hydropower that need to be understood on a broader basis. And this is why we will have this special workshop, and why the issue will be featured in our Integrated Energy Policy Report to be submitted in

November of this year.

Some of us, myself in particular, had a fair amount of experience in government with this subject. In my former position in resources agency I found myself dealing with subject quite bit. So it is very relevant. Hydropower, small hydropower in particular, is a featured piece of the renewable portfolio standard, more interest in that aspect.

So this is an issue of significant importance to this agency. Chairman Keese joins me here, as the other member of the Committee responsible for the production of the Integrated Energy Policy Report. And this is not the first nor the last in a long series of hearings that the two of us will be dealing with the multiple subjects that affect this report.

So with that, I'd like to ask Chairman Keese if he'd like to say a few words. And then we'll turn it over to Jim McKinney to moderate.

CHAIRMAN KEESE: Well, just welcome everybody here. And we had a very good workshop Energy Efficiency yesterday. I would like to try to convey to you that what we're charged with doing is being described and putting together this

Integrated Energy Policy for the state.

So it's important that we focus on the 50/60/120 issues that might tie in together in an Integrated Energy Report. It will be very complex. So the best job that you can do in conveying to us what you think those items will be here today in the hydropower area, the easier it will make our job.

Our staff has done some work. Obviously you're going to help us with presentations. Hopefully your questions will focus us on what is important from hydropower to be put in this Integrated Report so that when we come up with -- when staff comes up with the first report, when we come up with our report, we'll be as close as possible to what the state should be looking at.

That we won't have to come back and hear you say you've got it wrong. We're going to have to make a lot of revisions here. So the more you can help focus us on what's important in the hydro area, the better it will be. We were successful in that I believe yesterday in Energy Efficiency. I look forward to it today.

PRESIDING MEMBER BOYD: Al Alvarado and Jim McKinney are going to take over for us for the rest of the day.

MR. ALVARADO: Okay. I'll start. Good morning. My name is Al Alvarado. I'm the project manager for electricity and natural gas report, one of three different subsidiary reports that are being prepared in support of the Integrated Energy Report. As the Commissioners indicated, this is one of a series of different public events to review different subject matter that's going to be included in the -- it sounds like I'm going in and out, huh?

PRESIDING MEMBER BOYD: They have, quote, improved the sound system here. So if you're not speaking directly at it your voice trails off.

MR. ALVARADO. Yeah. Here I have to sort of hug the microphone. Well, we're going to be having a series of different public events in preparation of the subject areas that we're going to cover, and the different reports. Out on the front desk there is a schedule of the different public event.

I guess Monday we're going to be holding a workshop on emissions. On Tuesday there will be another workshop on electricity infrastructure assessments. Wednesday, natural gas, market assessments and so on. Senate Bill 1389 specifically calls for an assessment of the electricity and natural gas infrastructure, which involves consideration of numerous different system elements ranging from demand trends, transmission development to environmental issues.

And hydropower considerations, the subject of today's workshop, is definitely an important element to the energy system. That has numerous implications to the infrastructure and environment.

The discussion in any technical feedback that we do receive today, and for these next several public events, will serve to refine the staff's energy system studies, and the preparation of electricity and natural gas report. Staff is preparing the draft electricity natural gas report, and we are planning on releasing this for public review late July.

I guess specifically July 25th. So the technical analysis that will be included in these reports will provide the findings to support any policy recommendations that the Committee finds necessary to be included in the Integrated Energy

Policy Report.

So, we're very interested in hearing about your views. We are transcribing this workshop. So to help us track all of your comments this will require you to come up to the microphone up ahead, and please identify yourself and provide the recorder your card so that in our transcripts we'll be able to identify you.

We are open for additional written comments. If I may suggest to the Committee, allowing parties to file comments at a later date, maybe after this first series of June workshops, I might suggest June 20th for any additional filing of written comments that the parties may wish to present.

We are working on a very tight schedule since we are going to be writing this electricity and natural gas report. So if you do have any comments that you provide to us, the sooner the better. If there's any questions -- let me introduce Jim McKinney.

Jim is responsible for activities regarding hydro issues. He's also pulling double duty being responsible on project lead for the Commission second environmental performance report, plus many other aspects associated with hydro issues, too. Jim.

MR. MCKINNEY: Okay. Thank you, Al. I'll keep my remarks short because we are already not on the schedule we sent out originally. And I've got a tough job today. I am really excited to see the diversity of speakers an panelist here. One of our goals today was really to try to pull together the experts from different spheres who often do not work together.

We've got the classic FERK arena where the state and federal regulatory agencies and environmental community, producers and FERK all get together and have friendly discussions for ten to 20 years over, you know, a given hydropower project and how it should be operated, and how much electricity should come out of it, and how much it should cost.

And that's a wonderful event, and that takes place throughout the country, throughout our state. That's an ongoing party. But we've also got some other spheres of expertise within state and federal government that often do not get to be part of that. One just with our own example is the Energy Commission with the forecasting work that we do for electricity resources.

We have a lot of responsibility in trying to get our forecasts as accurate as possible to inform the supply demand balance. And that became very clear during the prior crisis when we were a key source of information on energy issues for the state.

We have, you know, relatively new agencies, like the Independent System Operator who also really need to understand all the different types of energy that are available to California to our grid to maintain system reliability. And that's something that's often not part of a project by project FERK relicensing proceeding.

Also here at the Commission we have our public interest energy research program, and we're doing some pretty innovative work in those fields. And this afternoon we'll hear from Joe O'Hagan and Guido Franco on a number of environmental issues, including global climate change.

I'd like to tell one brief antidote. A few weeks ago the Department of Fish and Game was kind enough to take many of us here at the Commission on a tour of the Feather River. And that culminated with a tour of the PG&E Powerhouse up in the upper elevation.

And it's always good to get out and see the resources that you're talking about, thinking about. Rivers are magnetic. They're wonderful. And in my mind they kind of exert a bit of a mystic in whether you're enjoying it with your family, whether you're fishing, whether you're producing electricity, whether you're trying to keep it in its banks.

They're complicated. They're kind of magical. And, again, I think they invoke a certain amount of passion in all of us who work all the different parts of issues around river systems, hydropower generation and environmental quality. With that, let me get to a few logistics.

We are being webcast. Hopefully out colleagues at FERK have been watching a part of this. So I say welcome to them and the rest in our webcast audience. Again, I will try to keep this on a pretty tight schedule. I've asked the presenters to err on the side of shorter versus the longer parts of your presentations.

We do have some time built in for question and answers. That can be the most interesting part of this. But, again, it's going to be a balance to try to keep this going and make sure everybody gets a chance to speak. We do have some breaks built in.

We basically have four sessions, two in the morning, two in the afternoon with a one hour lunch break. Bathrooms are out over here. There's some pay phones here. And if you need to use the phone, Xerox, computer, whatever, let me or Al know and we'll try to help you out.

Many of the CEC staff presentations that you see are powerpoints. Some of them were completed 20 minutes before we came on today. But those will be polished and revised. They will become part of the Integrated Energy Policy Report and the electricity and natural gas report subsection to which Al alluded.

Speakers, you may use the podium or you may sit here as you go through your presentations. As you've seen, these are directional mikes. They're very sensitive. So you kind of need to get close and speak straight, or our recorder won't be able to hear you and the audience may not be able to hear you as well.

With that, let me kick this off. I'm

very pleased to introduce Mr. Jim Woodward from our electricity analysis office. Jim is relatively new to the Energy Commission, although that's hard to believe. I think he's got an encyclopedia memory in capacity to really understand all the nuances of our hydropower system.

It's just he's become an amazing resource for the Energy Commission, and I think for the rest of the state. Prior to joining the Commission he spent 20 years with the State Parks Department across the street. where he did historical and archeological surveys throughout California, including a number of reservoir studies for DWR, PG&E, and the El Dorado Irrigation District.

His duties include analysis and forecasting for hydroelectric issues in California. He states that this is his first presentation on energy. I'm not quite sure that's true. So he warns, this could be a controlled release or a flood of streaming data. I'm going to turn it over to Jim Woodward.

MR. WOODWARD: Thank you, Jim. Thank you, Al. Thank you, Commissioners. And welcome everyone for being here for our first hydro workshop. Another workshop in a series leading to the Integrated Energy Policy Report. Presentations and comments may help us create a roadmap for the evolving role of hydro.

There's a story about a guy who was driving in New York City without a roadmap trying to find a particular bridge. He got off course, became disoriented, but kept driving through neighborhoods that became worse and worse. He became anxious, the panicky as darkness fell.

Finally, he saw cop and asked for directions. The cop thought for a moment and said, "Well, if you're trying to get to that bridge the first thing you should know is you wouldn't want to start from here."

When we say hydropower a picture of Hoover Dam comes to mind for many. It was on our Energy Commission calendar in May. So let's deal with that. Hoover Dam can generate 2,062 megawatts when Lake Meade is full. The peak months are normally in summer and fall, and are often just above 1,900 megawatts.

Peak energy production usually occurs March to May with over 500 million kilowatt hours a month. Hoover Dam was built to control flooding, to regulate river flows, and to store water. Power plants were included, mainly to repay the government for construction cost.

This is an out of state resource on the Arizona, Nevada border. Several cities in Southern California own Hoover entitlements, as does Southern California Edison. The list includes Anaheim, Azusa, Banning, Colton, MWD, Pasadena, Riverside and Vernon, with a grand total of 646 megawatts owned by California utilities.

For several decades this was the only significant source of imported energy, energy to California. Edison was the first to study the hydroelectric potential of Boulder Canyon. As seen on the right, in 1902 Engineer J.P. Lippincott was not enthusiastic.

The district in question is exceeding remote. As far as power consumption is concerned, there are no towns. A power company, to be successful, would have to very liberally assist in the general development of the country before it would obtain substantial returns on its investment.

Since Hoover Dam was completed in 1936

efforts to build nearby load have been rather successful. If you like what's developed here, be sure to give some credit to hydropower. If you don't like what you see, you can bet there's some other factor in play.

Farther down the river, the US Bureau of Reclamation built and operates 108 megawatt Parker Dam, paid for almost entirely by the Metropolitan Water District of Southern California. MDW's pumps lift water 290 feet above Lake Havasu beginning a 250 mile journey west.

At storage reservoirs, and along the feeder lines, there are 15 small generators that add up to about 100 megawatts. But on the Colorado Aqua Duct pumping load greatly exceeds the capture of energy from falling water. California now takes 5.5 million acre feet a year from the Colorado, a bit more than our rights to take 4.4.

Just to keep things simple, we agreed not to look at the Colorado River Delta in Mexico, at least for this report cycle. Imperial Irrigation District received 3.3 million acre feet at Imperial Dam near Yuma into the All American Canal.

It all flows down hill ending at Salton Sea, 200 feet below sea level. Along the way IID has eight run of canal plants with a total of 85 megawatts. The stability of the lake shore depends on continuing flows of agricultural drainage. However, the water evaporates, and salts accumulate, with no agreement yet on how to sustain this accidental oasis.

Through prehistory, Salton Sea has died and been reborn many times. I feel old fashioned here with emotion film compared to powerpoint many of you have. One pictures is worth a thousand words they say. And a computer can also use up a thousand times more memory.

The other great gravity-powered aqueduct delivers water from Owens Valley to Los Angeles. In 1913, construction of the first Los Angeles aqueduct was underway. This is looking north between Olancha and Lone Pine, with the Alabama Hills on the left.

Could it be darker perhaps with the light? Would be that okay with everyone? Thank you. Thank you, Will.

The next is of Owens Dry Lake on the right. LA successfully tapped four of the five streams that flowed into Mono Lake. The Lee Vining Conduit takes water from Rush Creek to Grant Lake, and from there, the Mono Craters Tunnel heads southeast.

The water is made to work as it falls, passing the Upper, Middle, and Control Gorge plants, each about 28 megawatts. There are 14 hydroelectric plants along the route with a total capacity of 269 megawatts. Eight of the plants are smaller than ten megawatts, including Cottonwood and Haiwee here as the aqueduct keeps to a grade above Owens Lake.

The largest plant in the DWP system is 75 megawatt San Francisquito number one in the San Gabriel Mountains built between 1913 and 1917. Abundant water was a necessary ingredient for the development of LA, including Fred Eaton's dream of growth to at least two million people.

These pictures through 1924 and 1982. Here's some basic factoid from California water 101. 75 percent of California's precipitation is north of Sacramento, and 75 percent of water demand is south of Sacramento. Each year about 193 million acre-feet of rain and snow falls on California.

More than half soaks into the ground, evaporates, or is used by plants for transpiration. That leaves about 72 million acre-feet of surface water. Of that, 35 percent has been developed for consumptive use, about 25 million acre-feet. These are gross numbers. Farms use four-fifths of the total, and of that amount, 80 percent goes to four crops: r ice, cotton, alfalfa, and irrigated pasturage.

In 1913, Congress allowed Hetch Hetchy and Lake Eleanor to be built within Yosemite National Park. An aqueduct system sends water west for 167 miles. Two different tunnels here lead to Kirkwood Power Plant, 114 megawatts.

The next big drop is to Moccasin Powerhouse, 119 megawatts. Yes, from there the water goes under Lake New Don Pedro. Every few years there's a push to breach O'Shaunessey Dam and to drain Hetch Hetchy. Flooding that valley broke the heart of John Muri, and help form the Sierra Club that survived him.

Former Mayor Diane Feinstein though, now our senior US Senator, dismisses this effort, calling Hetch Hetchy's system san Francisco's "birthright." Water is essential to San Francisco and the peninsula. But the city's power lines only made it to Hayward. Water and power lines cross the central valley in an area just peripheral to the Delta.

The electrical system provided a wealth of revenue for various municipal activities, though some maintenance has been deferred. A break in the underground pipe near Ripon last November cut water deliveries in half for a short while.

Shasta Dam, with 625 megawatts, is the largest generator in USBR's Central Valley Project. The dam has recently been retrofitted to allow temperature controlled release of water at various depths, in hope of improving salmonoid habitat. There's more here than we can introduce in 20 minutes, such as the Trinity diversion into the valley shed, which will be touched on later.

Shasta Dam reservoir, this is a graph just at random last December 2nd, 3rd, it shows ramping up every day between about 7:00 a.m. to 10,000 cubic feet per second. It's not energy, but flow release graph covering a week. Then I went down to 2,100 cfs until 3:00 p.m., back up to 10,000 in hours 16 to 22.

And dropping back to zero discharge after 1:00 a.m. This pattern continued for about seven days, except that on Saturday and Sunday things were much slower to ramp up. It's load following in a very large way.

One has to have fuel of course to have dispatch. Hydro is an energy limited resource. In February 1983, a wet year Folsom was spinning out about 200 megawatts, a big contrast to August 1990 when most of the lake bed was dry. Folsom was authorized in 1944, completed in 1956, ostensibly to provide 500-year flood protection to Sacramento.

Here's another view of high and low water, Bidwell Canyon at Lake Oroville. Is that focused okay? A little better. Thank you. February 1983, a wet year -- I'm sorry, May of '85, full pool, and gone down there October '92.

Oroville is the centerpiece and largest reservoir in the State Water Project. Oroville was built to divert and store surplus water, and to deliver it where it's needed using 660 miles of canals and pipelines. To get a sense of scale, the spillway under construction here is a mile long.

It takes two days or more to move water from Oroville down through the Delta. Water released from state and federal dam are coordinated, and are sometimes needed to push back the intrusion of sea water in the Delta. The aim is to keep salinity down at the pumps near Tracy.

This was the site of San Luis Reservoir in 1965, and afterwards with more than two million acre-feet in storage when full. I'm told this is the largest "off-stream" reservoir in the world. The turbines at Gianelli, between San Luis Reservoir and O'Neill forebay, do double duty: pumping water in off-peak hours, and generating up to 421 megawatts to help meet daytime loads.

The federal turbines at San Luis pump at San Luis pump water up to O'Neill from the Delta Mendota Canal. And during irrigation season, they spin in reverse, generating 25 megawatts, but it's not the same as pump storage. After water put over the hill, as it said, referring to the Tehachapis, it divides into two branches.

This is Pyramid Lake on the west branch, along I-5. From here it delivered to Castaic Powerhouse. I don't have a picture of it. It's the state's largest at 1,475 megawatts at best.

LADWP helped to finance construction when the state ran short of money, and in return they operate the plans and accrue the pumped storage benefits, sending some water back up to Pyramid Lake each night.

There's a net loss of 25 to 30 percent energy since each pumping and generation cycle loses some. But altogether it's about 85 percent efficient -- I'm sorry, each phase is about 85 percent efficient. The payback comes from the diurnal price differential, and to society generally by avoiding the cost of a 1,500 megawatt peaker.

The east branch of the California Aqueduct ends at Lake Perris, on a remarkably clear day, a man-made reservoir on a former potato field. This most heavily used reservoir for recreation in California, and water quality can be a problem. When water is released for distribution, it first goes through an eight megawatt plant.

Generating resources like these are not dispatchable, and don't provide ancillary services, but their output can be very predictable and reliable. The vast majority of dams in

California have been built without power plants. Though some have been retrofitted to include this feature, La Grange Dam on the Tuolumne River was built in 1893 on the left.

A four and a half megawatt plant was added in 1924, that by a diversion tunnel from the dam. Older water projects have seen many improvements to their water conduits. This is the main canal for Turlock Irrigation District, downstream from La Grange. The trestle over Morgan Gulch was later replaced by fill.

That's Modesto Irrigation District's line on the other side of the river. In the 1980's, TID added several small hydro plants to their canals. Two megawatt Hickman Powerhouse was their first. The map shows Dawson four megawatt, Turlock Lake 3.3, Hickman 1.1, Frankenheimer 4.7, Woodward, no relation, 2.3 megawatts, not a bad looking lake.

Farther south, Parker 2.8 megawatts, Canal Creek .9, Fairfield .9. Almost all added in the 1980's. The map shows neighboring South San Joaquin and Merced Irrigation District, but no Modesto, which was immediately north.

TID and Modesto have been feuding for

decades, but occasionally they cooperate to get something built. This is a promotional brochure from 1910, courtesy of the California State Library. Borrowing and building dams and canals was a big investment with big risks, especially in the early years with the shortage of paying customers and inadequate metering.

On the right is Turlock Lake. Along the system of the Tuolumne River you can see the remains of hydraulic mining tailings from gravel dredgers in the distance.

MR. MCKINNEY: You've got about five minutes, Jim.

MR. WOODWARD: I don't think so. Here they're building New Don Pedro Powerhouse with help from Bechtel Corporation, excavating the Don Pedro Spillway. This is SMUD territory: a full Union Valley Reservoir in June '71, and dry in August 1977. Even in a near-average year, SMUD has very little carryover storage in its hydro system.

Then we're looking west to Union Valley from Desolation Wilderness and out Wrights Lake. That's Island Lake with a little stone dam built in 1910, and Boomerang Lake. Water from this part of the Crystal Range flows down to Wrights Lake to Ice House Reservoir, then by tunnel to Jones Fork, 11 megawatts, Union Valley Reservoir, and its 47 megawatt powerhouse, then to Little Junction Reservoir, then by tunnel to 144 megawatt Jaybird.

Then into the South Fork American River to Slab Creek where it's either diverted to 224 megawatt White House or released into the river through one megawatt Slab Creek. After that, it will go through Chili Bar seven megawatt plant down to Folsom and Nimbus.

This is a fairly simple chain compared to others. Now a bit of SCE, a very early pioneer in hydro, it's the Sierra Hydro Plant located in Southern California, not the Sierra, built in 1901. They also had to develop for the Santa Ana River and 83 mile transmission line built in 1899 from Santa Ana #1 to LA, carrying 33,000 volts, a world record at that time.

Boyle hydro on the Kern River, built in 1904, inside in 1909. The original generators have been replaced. Ancillary services are provided by about half of our hydro plants over five megawatts, including most of the capacity.

Kern River, a T-line, now up to 75,000

volts being upgraded with new insulators in 1916, and Cajon Pass being installed in 1916. Rush Creek Power House about 19223. Building of wooden stave flow lines to Bishop Creek Plant Number Two in 1908. There are many miles of diversions of stream flow creating miles of what's called bypass regions.

But the water itself is not harmed during generation, not one molecule. But the quality of water is often impaired. The Bishop Hydro Plants provided Tonopah with its first electricity in 1905, and a lighting district was formed.

Some hydro plants, large and small, continue to be important for local reliability, especially in rural and remote areas, such as PG&E's Battle Creek Plants. This is the flag ship for Edison Big Creek, hence 243 miles to LA, 115,000 volts. It was technology that matured very quickly with efficiencies much higher than the thermal plants.

Huntington and Shaver Lakes formally have been used by mill ponds. Dams had to be raised. The lake was accessible to the public, not by car, but by railroad built by Edison.

There's Big Creek Power House Number One under construction 1913.

Farmers were probably the biggest beneficiaries of early hydro on the Kaweah, Tule and Kern. Electricity made ground water pumping cheap and reliable, displacing windmills and opening new areas to farming. This is a pumping plan in an orchard near Exeter.

The hydro plants themselves have an average life expectancy over 50 years, and California the average life is now 40 years -- the average age I mean. The landscape effects are probably irreversible, but largest that I would see from hydro eliminating large areas of natural habitat.

Agricultural power, particularly irrigation pumping evened out the system load factor for many utilities. By 1895 the power hydroelectricity craze had swept California. This is the Dillon Point tower carrying 60,000 volts from the Yuba River across to the Carquinez Strait to help power the streetcars of Oakland.

Some say the Mokelumne Canyon is another little Yosemite, but to me it looked more like a little Hetch Hetchy. Some lands have sites and areas that are archaeologically and culturally significant, not everywhere, but in places these are significant environmental resources.

I just need to mention that in case it doesn't come later today, there are resources deserving environmental stewardship. Some struts meet the federal criteria for possessing historical, archaeological and engineering significance, even if they're remote and rarely seen.

Some watersheds have been extensively developed, such as the North Forth Feather River, as Jim mentioned. Last month, staff looked at these areas, including Carbou, 75 megawatts built in '75 and Rock Creek on the North Fork Feather System.

This graphic gives a brief summary of PG&E's system and describes the slides. I'd like to quote here from a Ph.D. dissertation by friend and colleague on the fundamental conflict that evolved, and was apparent by 1906. The extensive hydroelectric development brought power companies into conflict with the National Conservation philosophies of Theodore Roosevelt's administration.

In 1907 the supervisor of Sierra National Forest near Fresno wrote this to his boss Gifford Pinchot: "In brief, they have surveyed and estimated all the power in this forest, and have filed on most of it. They expect to reservoir and use the whole watershed of the Sierra Nevadas, with as little payment as possible, and with no attention to the broader demands of higher civilization for outdoor life."

My personal regards with the managers are excellent, but we do with entirely primitive capitalistic instincts in training. It is one chain, Wishon and Eastwood, Huntington and Harriman, agents, attorney, principles, etcetera. To one and all of them the entire modern rooseveltian theory of public utilities is lunacy, ignorance, and diabolism.

Well, that said, this couple of graphs give a summary of the cumulative generation here in California, hydro the bottom in blue. Very important early help displaced all which was expensive and firewood and fuel, which was becoming scarce, but it's plateaued.

We've added in the last decade since 1990 less than ten megawatts, less than 100 megawatts altogether, of new hydro. On the right is a graph that's also in the handout showing capacity relative to river runoff in this regard. And some rivers, like the Kings, the Stanislaus, have a much higher capacity development compared to their runoff.

Next page in the handout shows ten hydrologic regions as defined by DWR. Within each region we show in orange, the middle bar, average precipitation per year in millions of acre-feet. The average runoff is in purple on the right, also in million acre-feet. The blue bar on the left shows dependable capacity times 100.

The Sacramento River has about 5,700 megawatts. San Joaquin Basin has over 4,000. The third largest is Tule Lake Basin from King's River south of the Kern, 1,800 megawatts. The Central Coast and San Francisco Bay Areas have practically no hydro capacity.

Above the bar graph is a figure in red showing precipitation this year through May 1st,. Where rainfall falls is important. Having 125 percent of average on the North Coast is no particular help to statewide generation. And having 75 percent of average precip in the

Colorado Deserts is also not significant in terms of energy.

Total hydro generation varies with runoff as one would expect, but it's not exact. In the wettest years, 1983 and '95, installed capacity is not adequate to use all available runoff. But in calendar year 1997 began with a flood, with warm rains on top of snow, causing early runoff and generation still dropped that year.

Average by the way is 37,290 gigawatt hours. Last year we predicted supplies would be 85 percent of average, and actual general was 84 percent of average, several complimentary areas may be involved. For 2003 we are forecasting in-state generation will be 108 percent of average.

The right side shows the mix of California Energy Resources, again, in your handout hydro on the bottom level. Practically all the fuel for our hydro plants comes from the west, sometimes from the sub-tropics, usually farther north in the mid latitudes.

Twenty-four percent of all the solar energy that strikes the earth is absorbed by water, including heating and evaporation. Water droplets on the right on the right are obviously filmed in a studio. In nature, they quickly reach terminal velocity, flatten out on the bottom, and dome-shaped on top.

In reality, they look more like hamburger buns. Here's a satellite photo showing water vapor from April 29 when a low pressure system parked offshore from the California-Oregon Border. It pumped in moisture and fuel water by the megaton. PG&E is one of the half dozen or so utilities that still do cloud seeing opportunistically.

On the Feather River it's believed this increases runoff by an impressive seven percent. On the right side is PG&E's Caples Lake along Highway 88 in Amador County. The vast majority of our fuel supplies arrive from November to April, and by November, next November, they may be gone.

That's May '82 on the left, looking east to the Sierra Crest, with Mount Whitney at the extreme left. On the right, November 1990. The water content, the snowpack is measured in great detail. A purple line is this year notice we had a big boost, and then a rapid decline as temperatures warm up.

There's a lot of spill going on right now. That's Plumas-Eureka and the Northern Sierra. One of the great things about hydry is that no one expect you to be exactly right. We track runoff forecast that DWR, high, medium, low forecast when compared to medium and record low. And we're still right about at the median for runoff in the Sierra, 13 major rivers that we plant.

Timing of the runoff is also important, as we'll later from Maurice Roos. This is a late spring snowpack in May of 1982 in the upper San Joaquin. So thanks to late season storms, California has escaped the drought definition for now, as has Washington and most of Oregon.

The outlook on the right is that drought conditions will persist or intensify Nevada, Arizona, Utah, and Western Colorado and New Mexico. This is bad news for Lake Powell, which may see a record low later this year. Glen Canyon Dam was finished in 1964.

The power plant that had been retrofitted have about 1,300 megawatts. All the reservoirs on the Colorado can store about four years worth of average runoff. But the region will be hard hit by prolonged drought. The flip is always having a risk of too much water for rivers to discharge within their banks.

The typical floodplain that would happen in every two and a half to three years. Merced River coming out of Yosemite looked bank full in January '82. 1964 flood on the Eel collapsed a section of Highway 101. Pardee Dam, now owned by East Bay MuD, spilled here in February '86.

The photos on the right from TID's history about Don Pedro helping to alleviate flood damage in 1950 and '51. Flooding occurred in February of '86 closing I-5 south of Sacramento when ten inches of rain fell in 11 days. It's also damaged and destroyed several generating resources, such as Santa Ana #2 in 1938, a flood that killed 19.

This summarizes the extent, aerial extent, of floods and droughts through the early '90s. Note that droughts are much bigger and much longer. When rivers flood they do their work and damage in a much shorter amount of time. Flood control benefits --

MR. MCKINNEY: If you can move to wrap

it up, Jim.

MR. WOODWARD: Okay. -- are very difficult to quantify. But I'm just glad to say I'm glad to work here in a floodplain, at least while we're here on the first floor. This winter and spring we ask hydro owners for information to upgrade our understanding of the hydro system. This is, again, in the handout.

That's our total sample of what we understand for hydro over one-tenth of a megawatt plants what we tried to survey and what our response was. Based on those who did respond, energy was the -- this is the distribution of ownership here in California. And that's, again, in your handout.

PG&E being the largest owner by capacity, this is the other that's exploded on the right. We ask managers to rank energy production as high, medium or low. Most of our contacts chose not to answer or are still finishing their questionnaires. You know who you are.

Energy was one of eight functions we asked people to evaluate. The others are flood control, inter-basin and water diversion, storage recreation and water supply, navigation, fisheries, and all other environmental concerns.

We also ask them to rank these purposes one to eight. Based on those who did respond, energy was the most important resource for 70 percent of plants in our survey. Flood control, consumptive water supplies are close, but well behind as primary purposes.

But when these answers are weighted by capacity energy production drops to 40 percent, as the foremost purpose, and a flood control is close behind. Local water supply is a little larger. Once more on the left we're looking at energy production. It shows how often it ranks as the number one purpose, about 40 percent of the time when the answers are weighted by capacity.

You expect this for IOU's, but it's not always true. Two more survey results, very briefly, here's a bar graph showing capacity of where the plants are located on the rivers that were historically accessible to anadromous fish. Aspen Environment Group helped us with these, great help here, in processing data.

We're very confident about this. Ninety-two plants with over 6,000 megawatts of dependable capacity are indeed located on reaches formerly accessible to salmon and steelhead habitat. 112 plants with 5,000 megawatts are not in that habitat. Well, they might affect freshwater species and other concerns.

Most of the unknowns are due to uncertainties about what's accessible in the wettest years. Throughout the summer we import energy from the Pacific Northwest, which is substantially dependent on hydro. On the right, courtesy of David Vidaver in our office, is a Northwest Flow Duration Curve for the top 100 hours in July in five years.

For our one there's not much difference in capacity between the wettest and driest years. Hydro is energy limited resources we said. And because of this the capacity declines rapidly over time in the driest years. But this is the type of information we're trying to get for California.

What can we count on from hydro in the top hour, top ten, 50, 100 hours to meet peak load? Runoff varies tremendously as a couple rivers, Tuolumne and the Yuba, over 50 years of data. A tremendous year to year variability. Generation is much less than that, but still varies by an average 25 percent change a year to year up or down.

And I just have to point out that Yuba River never had an average year. It's always more or less. We'll skip this. We don't expect much new development at all of hydro in California. The only new things will be things like (indiscernible), four megawatts down in San Diego, the largest roller-compacted concrete dam in the US.

Large dams still are getting built in Columbia, Ecuador, and especially China, which has the world's project, Li Peng. The administration of the Communist Party Number Two, the administration of a country's national affairs becomes easier when its rivers are tamed.

Floods killed about 300,000 people just last century. Last Sunday the gates were closed on Three Gorges Dam. It's supposed to generate 18,000 megawatts by 2009. Over a million people are being displaced, including boat trackers who pull vessels upstream along tributaries of the Yangtze.

It worked here for thousands of years doing this. We've seen displacement like this in California on a smaller scale, Lake Berryessa farmers were bought out. They never found other lands that they could farm or ranch. When LADWP bought up water rights and land in Owens Valley, some of those farmers moved to the Imperial Valley and did well.

Some of their descendants have maintained a distrust of big-city utilities and tend to take it out on Edison and the Met. Before I took this job I would marvel at scenes like this. Now I see wasted energy, and a terrible barrier for fish. There are many small barriers and waterfalls that are still passable to fish as we could reasonably infer.

And our hope is to restore access all over the map, tapping the resources and revenues that hydropower still provide. Joan Didion wrote, "I know as well as the next person there is considerable transcendent value in a river running wild and undimmed, a river running free over granite, but I have also lived beneath the river when it was running in flood, and gone without showers when it was running dry." Unquote.

Many of our rivers remain wild in character. And much of the infrastructure was built to last a long time. It delivers relatively low cost, relatively reliable renewable energy with several environmental consequences.

I do have one question in conclusion that some of the following speakers may be able to address: How can environmental outcomes be improved, and at what cost, and at what risk? Thank you.

MR. MCKINNEY: Okay. Thanks very much, Jim. Moving to our first panel we're going to have speakers from the California Independent System Operator, Pacific Gas and Electric Company, and the Sacramento Municipal Utility District. The theme for the second panel follows on Mr. Woodward's presentation.

It's really trying to give us a sense for what hydropower's role is in meeting system reliability goals and utility portfolio management goals. So if we can have our speakers kind of move to the front table.

Our first speaker for our first panel is Ms. Mary Jo Thomas, system operator. Ms. Thomas has worked in the electric utility industry since 1993 and holds a bachelors in Electrical Engineering and a Masters in Business Administration.

She's an Operations Engineer in the Load and Resources group of the CAL ISO, Operations Engineering and Maintenance Division. Her primary responsibilities there are to develop the CAL ISO semi-annual assessment of loads and resources to investigate and address environmental issues that could affect generation in the CAL ISO control areas.

With that, I'd like to welcome Mary Jo.

MS. THOMAS: Thank you, Jim. There we go. I had to get the technology down. Good morning, Commissioner, and other stake holders in this process. I'm Mary Jo Thomas, here to discuss the importance that hydro generation has in maintaining grid reliability for the California ISO.

Hydro generation is important for its ability to provide capacity to meet demand requirements, as well as meeting reserve requirements. Hydro generation provides over 22 percent of the capacity required to meet the seasonal peak loads during the summer peak hours.

ISO anticipates that there will be enough resources to meet this summer's peak load. However, we rely much on import that come from the

Northwest. The Northwest being primarily hydro generation. There's over 8,470 megawatts of hydro capacity from run-of-the-river and pond storage. And approximately 6,000 megawatts at that capacity is available during seasonal peak hours.

We also have 2,760 megawatts of pump storage. And then in addition to that, there's 626, I think Jim Woodward had quoted 646 megawatts of dynamically scheduled generation from Hoover Dam. Most of that primarily comes from Southern California Edison and MWD.

There's some other munis that don't necessary always schedule that on generation dynamically, and it comes in as imports. This graph represents other resources in ISO control area. The hydro provides, you know, again, 22 percent of that generation. It's the oldest generation that was born in California.

I have a slide a little bit later. I probably won't go over it, but it's in your handouts. Hydro generation provides most of the operating reserve requirement that we use for spending reserve. The WECC requires that we provide five percent of our capacity, our load that is met by hydro capacity in seven percent of thermal capacity for maintaining operating reserve requirements.

Half of that reserve requirement has to be spending reserve. Most of the spending reserve in most cases generally all hydro capacity. Thermal capacity can provide spending reserve requirements. However, as it relates to hydro, whereas hydro can ramp up quite a bit faster than thermal hydro ramps. For instance, a hydro plant might ramp up better rate of ten megawatts per minutes, where a thermal capacity is ramping up at more like one or two megawatts per minute.

Using the 2003 summer forecast, ISO would need 1,279 megawatts of spending reserve to meet our requirements. ISO forecasts hydro capacity based on historical hydro production. This graph represents the 2002 summer hydro production, as well as the spending reserve.

The gray are on the top represents the spending reserve that was set aside using hydro. The red dots represent out top ten load days where we were above or right around 40,000 megawatts of capacity. This graph here shows the hydro production over the last -- well, during 2001/2002. Then what we've got, the blue area represents what we've received so far this year.

I also threw in a little chart there on the top, what the inches of snow water equivalent was through state average. And I couldn't really correlate snow water equivalent to hydro production. And this is during the time of peak for each day. So, again, hydro is more energy related. It is affected more on the energy level limited.

So as far as during peak hour, it's generally always available to us. As mentioned earlier, we also rely much on generation from import levels, or imports. And much of the imports comes from the Northwest. The Northwest being primarily all hydro generation.

These graphs represent the snow water equivalent levels for some various base in the Northwest. I pulled this graph yesterday from the website. There's a website where you can actually grab that data if you're interested. However, this really shows that the snow water equivalent levels this year are more equivalent to 2001 as opposed to 2002, running around 80 percent.

This graph here represents at time of peak the import levels that we saw at the

California ISO in 2001 and 2002. Again, the red and black dots representing our top ten load days. And as you can see that when the snow water equivalent levels were lower in 2001 so were the import levels.

In 2002 when snow water equivalent levels were at around 100 percent we had quite a bit more imports available to us. This year we're expecting that imports are going to be closer to the level that we experienced in 2001 where the yellow area represents our forecast for this year.

I made this real quick in brief. Are there any questions?

MR. MCKINNEY: My intention for this Panel to hear from the first three speakers and then open it up for question and answers, if that's okay with you.

MR. THOMAS: Okay. Sure. I can just throw these up just to let you know that these graphs are here showing what was mentioned earlier by Jim Woodward that there hasn't been much generation in the last decade, hydro generation. And then there's also a graph showing what we've gotten in thermal.

And, you know, one of our concerns is

that there's 3,000 megawatts of thermal generation that's over 50 years old. And we haven't been notified that that's going to retire. But that generation was really only intended to be around for about 20 or 30 years. So it is a concern that we have.

MR. MCKINNEY: All right. Thanks, Mary Jo. Our next speaker is Mr. Randy Livingston with Pacific Gas and Electric Company. Randy is the lead director for PG&E's Power Generation Department. In this role, he's responsible for managing all aspects of the hydro and fossil generating assets for PG&E.

He has a broad background in power generation technologies and operations that include design construction and start up for over 500 megawatts of geothermal capacity at the Geysers. He has worked or managed each of PG&E's current and previously owned gas fired thermal plants.

And he's familiar with all aspects of PG&E's hydro facilities. Randy is a registered mechanical engineer with the State of California. And his topic will be addressing the role of hydropower meeting customer energy needs.

MR. LIVINGSTON: We're having a technological problem here.

PRESIDING MEMBER BOYD: It works much better with a hard copy. I don't know if you have hard copies.

MR. LIVINGSTON: Not in color. Well, we're going to get a start there. Good. Thank you. I appreciate the opportunity today, and we look forward to participating when the ISO report gets developed.

I've often thought of utilities' job and dispatch has trying to estimate the time, a family in the Central Valley somewhere is going to turn on the air conditioner and have lined up gas from either Texas or BC two day in advance, have plants warmed up, have the water going down the river, so that exactly the same time that air conditioner comes on the electricity is there, it's at 60 hertz and at the right voltage.

And that's a lot of what the dispatch process is all about. The PG&E supply portfolio today includes the contracts to manage some fossil generation in state and Northwest hydro, nuclear and short term purchases. In general today, we have less dispatchable power than we have had in the past.

But of that entire mix, about 20 percent of the yearly supply for PG&E comes from hydro. Despite the 20 percent, the role of hydro, as Mary Jo alluded to, is critically important in meeting customer needs. In looking forward at future capacity additions we've seen a lot of that has been combined cycle technology.

The majority here is all combined cycle coming on. And we're seeing, you know, the wind or there's some other that is really off peak generation that we're working on managing. Hydro plays a keys role in running the system as a renewable and dispatchable resource. And this dispatchability is become more and more important, has more and base load, comes on line.

It also has a unique ability in providing -- has a non-remitting resource, some particular advantages in that it comes on line as we come up during the day. Not only is not a emitting resource, but at the time of the day when the peak is high, when thermal units might be coming on, and especially with some of the older thermal units with higher ozone precursor emissions that happen during the hot time of the day, and in certain air basins.

Those ozone precursor emissions are affecting air basin quality. So there's kind of a doubling affect with the cycling of hydro that you're able to help with air emission impacts. In looking at hydro as peaking resource, traditionally this is last year, or 2001, on a peak day, you see a large portion of the load is really base load.

And those two yellow and blue, yellow being the thermal resource that helped meet the load, and the blue being the hydro, are the two pieces of California's energy supply mix that do come on to help meet that load.

In looking at a particular recent week that can be a significant portion of the daily load, this is on PG&E system and much of the dispatch, or the customer demands that come during the day and drop off at night are met by hydro.

Predominantly are held pump storage has a big part of this, but also lots of PG&E system is set up where the after bay of one unit is the four bay of the next. And this cycling helps meet that particular load. Increasingly important on the system, and especially has the generation where looking at has the capacity additions to California come on line.

Generally, the PG&E system operates above major water supply reservoirs, the Pit River above the Shasta, the Feather River above Oroville and so on. However, in operating a system like this many needs may have to be taken into account, including flood control that was alluded to, consumptive water supplies with various waters, aid in season irrigation districts, recreation requirements for lake levels, generation requirements and so on.

We've seen a lot of multiple attempts to try and model the operation of PG&E system. We obviously are using models also. But often times these models becomes flawed because of the assumptions that have to be made in looking at these operation constraints.

And typically, we've found history is the best indicator of operations. I note we're going to talk a little bit this afternoon about global warming, but hydro has a key role as a non CO2 emitting resource. And we've seen several reports talking about the potential impacts on global warming and what it might have on hydro generation.

Generally, the impacts we've seen is certainly we expect over time, higher snow pack elevations, but generally those changes are small in comparison to the seasonal changes we get in the amount of snow pack that comes in.

I think Jim shows the Yuba River differences with one standard deviation. And I think as we're looking forward we're expecting that, you know, compared to the size and flexibility of the system of what we've been dealing with on a yearly changes global warming may have a less minor impact on generation level because of that change.

I think certainly we've talked about trying to work on going and balancing multiple and, at times, competing interests in a way that help work the balance that certainly FERK requires, and other forms require. And we've seen that, you know, in trying to create that balance it takes a lot of work. It takes a lot of careful consideration.

And, you know, certainly through the many folks in this room who have been involved in relicensing proceedings, it's been a forum for us that, while very difficult at times, has helped achieve some of those balances in very positive ways.

And certainly if there's interest of the Commissioner or the ISO participating in those forums, we'd invite them. Thank you.

MR. MCKINNEY: Okay. Thank you, Randy. I apologize for the quality of our visual equipment there. Our next speaker is Ms. Pam Taheri with SMUD. Ms. Taheri has over 20 years experience in the energy industry. She currently oversees SMUD's energy risk management group.

Her responsibilities there include development of the annual fuel and power budget, as well as energy risk management policies and procedures that are consistent with the overall business strategy adopted by SMUD's Board of Directors.

Prior to joining SMUD in 1998, Pam has held a variety of technical and management positions in the area of risk management, power marketing and trading, energy portfolio planning, contract negotiations and system operations with various companies, including Aquila Power, CNG Energy, and Pacific Gas and Electric Company.

Ms. Taheri is also a registered civil engineer with the State of California. Pam.

MS. TAHERI: This is working out. Hi. Hello. Can you hear me? Okay. Good morning. I'm very happy to be here on behalf of SMUD to give this little presentation. Good morning, Commissioners, and ladies and gentleman.

What I'm going to try to do is go through a little bit probably more detail regarding our project. Unlike PG&E, obviously we don't have the size, but that's not necessarily to say that we don't have similar type of complexity in terms of challenging jobs with hydro.

A little bit of background about SMUD, we're the sixth largest publicly owned electric utility in the US. Our peak demand is about 2,800 megawatts. And usually that happens when it goes to at least 105 degree in the Sacramento area.

So if you guys feel the heat, that's when we get the 2,800 megawatts. We sell over ten billion kilowatt hours of electricity to the customers, generally in the Sacramento area. This is what our energy (indiscernible) looks like.

Of the 2,900 megawatts of needs, of course that only happens in maybe ten really hot days when it's 100 and, you know, plus degrees. Having said that, we do have a significant portion of our capacity that we own ourself. We have 688 megawatts on the upper American River project, that's hydro.

And we also own cumulatively a little bit less than 500 megawatts above the resources, primarily through arco generation facilities. Of course we have a lot of adversity in terms of our resources. We have solar. We have wind. And we're very proud to be able to say that we take pride in all of our renewable resources and take that seriously.

And off that particular mix of resources what we generally expect, of course assuming an average year, which never happens, about 45 percent of the energy is being provided out of our own generation, including the one that I just pointed out.

And of that, about 20 percent of it is coming out of the American River project. Another 40 percent of the energy is provided long term contract. That means the multi year involved in a one-year type of contract that we procure in advance. Okay.

Even though we said that hydro we have a 688, but part of the portfolio, in terms of our long term contract, is that we actually also have a long term contract with the Western Area Part Association, the marketing of the Central Valley Project.

So some of the comportion of all energy, in addition to our own hydro generation, also comes from a hydro resource. So when you add that up it's probably over 40 plus percent. Our portfolio comes from hydro related source. Now, this is not considering the remaining energy, which is another 15 percent or so, depending on the particular year that we import from various sources, including Northwest.

So when you put it all in perspective a significant, significant portion of our energy comes from hydro and hydro related sources. I'm just going to through these last quickly because I know time is limited. I'm going to be talking a little bit about the quick facts. Jim has already shown some of our slides on it.

And then I'll also talk a little bit in our perspective what are values that it brings to the table in terms of our portfolio. A little bit of quick facts on Upper American River project, we were granted a license, a 50-year license, in 1957 from the then federal power commission.

And of course now it's been switched over to the FERK. Of that Upper American River project there's 11 reservoirs, eight power houses, 180 miles of transmission lines. Okay. We got (indiscernible) to be 688 megawatts, and then an average generation is about 1.8 billion kilowatt hours.

Here's a map of our system. What it does is the project basically takes into about over 50 river miles. And at the same time, the elevation of the drop, because this is a cascading type of hydro system, unlike some of the other ones where it's run of the river.

And it cascades over about a mile in elevation. Okay. If you look at it you will see that there's three blue body of waters. And that's basically our storage reservoirs. As Jim pointed out earlier, compared to some of the other big players. It is not a significant amount of storage.

There's about approximately 400,000 acre-feet of usable storage, cumulatively for the three reservoirs. And the rest of them, even though we have 11 reservoirs here, really what we consider before base and after base to attenuate, you know, the power house close to a point where it makes sense.

The primary values that we see for the Upper American River project, these are not the only ones, but these are the primary ones, is that this project is built for the purposes of power generation. It's not meant to help flood control. I mean it's nice if we can.

But those are not up their functions. The primary function of our system is for generation. And the 14 things that we looked at were system reliability, for economical power generation, for the operational flexibility that it offers us, and also for the storage capability, although it's limited.

Okay. On one hot day, like last week, we can count on at least generating 650 megawatts of reliable peaking capacity across the peak. And generally, for our system, we're talking about anywhere between four to six hours in any given day.

Usually, it happens in the late

afternoon and ramps up until about 7:00 at night. Okay. We expected to offer real time operating reservist. As Mary Jo pointed out earlier, hydro is very unique because although there's seven percent of reserve requirements that are unique for operating, what you need is for hydro only five percent, as compared to the typical seven percent out of your thermal.

Well, why is that? Because it can just basically be there just like that. So we value that because that helps a lot. It also helps in terms of our support. Although a lot of the import of Northwest and other places where it's considered to be at market price cheaper than some of the other resources, but what we see is the voltage has relationship in terms of how long you have to bring that power in.

So having something that's local helps a lot. So we value that for the fact that it is close by, imported resources. At the same time, we also value the fact of back start capability. I don't know how many of you in this room know, but what SMUD has been doing is, although we follow our load on a second basis, we have officially declared and accepted to become our own control area as of last June in 2002.

So this back start capability is really important for us because we have several different units within the Upper American River project that can offer us in case the area blacks out. This has already got on-site stationary backup generators such that it would help us to be able to kick start our system.

And of that, we have the (Indiscernible) Power House, which has about 82 megawatts that can do that for us. In addition to that, our biggest (indiscernible) on the hydro system, the 224 megawatts of White Rock Power House, which is at the end of this particular river system, has also got that capability to help us start it.

And that is a significant about two-thirds of all back start capability, because our thermal units, we can count on McClellan being one, Carson being the other. But those only offer about 160 megawatts. So when you compare to that two-thirds of what we can do in terms back start capability comes (indiscernible).

As I mentioned earlier, average is only in the eye of the beholder. We haven't seen too many average years at all. But it does offer to generate about 1.8 billion kilowatt hours should you hit that average. And this year turned out to be somewhat close to the average.

And given that though, there's quite a bit of fluctuations in our system. We can swing between 800.8 to 2.8 billion. So give or take, it's a billion on either way in any given year. Okay. This is only our system. Imagine that we also have contracted part of it with the Central Valley Project.

Unfortunately, it either rains or it doesn't. And it affects everybody that's in Northern California. I'll talk a little bit about operational flexibility. I think I'm not going to belabor the point on operating (indiscernible). We just love it.

Regulation is important. We have to be able to have the ability to ramp up and down, simply because we really don't know, as Randy pointed out, you know, if you don't turn on the air conditioning we may not need that. And then so you have to have the ability to be able to follow it a little by a minute by minute basis.

Okay. Storage capability, that's very

important to us because we don't know whether you're going to have back to back dry years. So what we need to do is we are counting on our hydro to provide a lot of that peaking capability for us. So what we do is we have to make sure that there is sufficient storage from year to year such that we can go ahead and know that next year when it gets to 105 degrees, we still have enough water such that we can count on its peaking capacity in a reliable fashion.

We do planning basically looking at a 24 month horizon. And it's really important not to worry about this year, but look ahead and say, my God, it's my job to worry. What happened if it turned out to be another dry year? What would happen then?

So it's very important to us. It's also important, too, because prices can be high, be it gas or electric. But it all has interrelationships. And knowing that I have a little bit of extra storage in the reservoirs, that I can count on generating next year, give me a better hedge in terms of what I will be able to forecast, what it will look like in terms of our power purchase cost.

Last, but not least, we say, okay, we build this project for power generation. That's not to say that we don't recognize that there's a need to balance. So there's some considerations in here to show you that we do look at other aspects as well.

In particular, two years ago I actually accepted on behalf of SMUD at the National Hydro Association, the stewardship award for recreational facilities. As many of you may cap up in our project, you may be aware that it's pretty expensive.

In addition to that, we're also looking at obviously we need to maintain in-stream flows. At the same time we also recognize that the stamp safety requirements that we need to make sure that it has to go into the fold. In addition to that, we recognize that everybody likes to have a good time, be it boating, fishing or otherwise.

So we make a very, very important effort to coordinate in particular with Forest Service in case like, two years ago when we thought, well, gee, we're not sure if there's enough water because it's been dry, that we could keep our boat ramps operational.

But then because people that tend to go boating up in up reservoirs would have to haul that truck, haul their boat, all the way up, and it takes a long, long time, we want to make sure it's well coordinated. Sure, we anticipated that's not going to happen, that boaters will already have full running so that they don't have to haul and just to get all bent out of shape.

Because by the time they get out there, there's nowhere to be had. We certainly also work with the rafting industry to make a reasonable effort to make sure that even those downstream for all project, because Chili Bar, which happens to be owned by PG&E, is part of the White House Power House, that hopefully we can all provide sufficient rafting flows to make everybody happy.

That's it.

MR. MCKINNEY: Thank you, very much, Pam. Let me do a time check here. I'm thinking that we'll just kind work through today to get back on schedule. I would like to curtail the break that was scheduled for ten or 15 minutes ago, and propose we have a shorter lunch.

And perhaps we're willing to go until 5:00 because a lot of folks have come a long way and did a lot of work preparing for their presentations later in the day. I think this has been a very interesting and informative series of presentations from the panel.

And I'd like to ask the Commissioners if they have any questions for any of our speakers here?

PRESIDING MEMBER BOYD: None from me.

MR. MCKINNEY: Any audience questions? Karen.

MS. GRIFFIN: I'm Karen Griffin from the Energy Commissioner. You talked about the importance of hydro in spinning reserve . What is your sense of how much variation that causes in in stream flows, and how much consequently environmental impact that has versus the other kinds of power generation that you can use the system for?

MR. LIVINGSTON: There's a couple different definitions of spinning reserve, but I'll use the definition that spinning reserve is capacity ready to meet load if things change. That's general what we think of as spinning reserve. The unit is plugged in and literally spinning.

But your question really goes to as load comes up on a particular power house what happens to the in stream flow in the river. And while much of PG&E, most of PG&E, system and SMUD system is designed that the after bay of one unit is the forebay of another that reach of river is really, in most cases, a reservoir, or a mini reservoir.

And there's not a real change of the actual reach. So it's done as a bypass. The generation is done on a bypass to the main river. That's true in many cases, but not all cases. And in the case of much of PG&E's cycling with our Helms Project, that's 1,200 megawatts, but also pumps in the opposite direction.

So between the pumping load and the generation load you get a lot of capacity to meet that daily load fluctuation that customers demand.

MS. TAHERI: I guess from my perspective I don't if it's so much the instrument of flow. Of course the quantity always is important. But I think what's more important is that in terms of whether there's going to be sort of ram breaks, and that you have to stick with in terms of your storage reservoirs and things like that.

Because to the extent if you can't fluctuate your reservoir, okay, then during the one hour when you really needed it, you may not be able to pull out any more water, let's say, if you're already at a certain level. So, they're making some impact due to, you know, that kind of an elevation change that could potentially make a difference in terms of what may or may not, in terms of the capacity that's available for spin.

MS. THOMAS: From the ISO's perspective, the reason why we rely more on hydro is that there is a lot more hydro capacity, and a lot more hydro generators out there that can provide spinning reserve than there are thermal generators.

So, from my understanding is that when we dispatch a hydro generator the water is being bypassed. So we simply ramp up the generators that are already spinning, because spinning reserve would mean that the generators are running at a low level.

So it just means that more water is going through that was previously being bypassed.

MS. GRIFFIN: Okay. And then I have a second question. There's been an allegation that with the change in the market design that there are pressures or opportunities of the hydro owners to shape the water more, to use it in a more flexible fashion, which has adverse environment consequences in terms of the very ability of the hydropower.

So I wondered, have you observed a change in the management of the hydro system so that the water is shaped more according to the real time or near market price?

MR. LIVINGSTON: If you look at past history, one of the things that pre-market, there did exist a market, which was reflected in the demand of customers, and was reflected with bilateral calls back and forth between the different generating and utilities in California.

So in general, that same role that hydro has provided in the past is the same role it's providing today. The market, as it existed, provided at least some signals that generally in mind did the same things that had always previously existed.

MS. TAHERI: Generally speaking, I agree with Randy. I mean the wholesale market has been live and well for a long, long time. And then I guess nobody told the weather that we've been deregulated. So I don't know if it knows the difference.

Having said that, there is a shape in terms of pricing on a seasonal basis. Summer is usually the highest in California just because we are a summer driven, you know, state. Wherein as Northwest they tend to look at winter being their highest.

So because it is a Western system West of Rockies, and we are all interconnected in so many ways through a transmission in our resources, that what we see is basically two hump camel. I see a winter peak that's more driven probably by the weather patterns up in Northwest. And I see that there's a summer pattern that driven more in California.

And remember, we almost account for 50 percent of the total in the west. Having said that, the shape generally doesn't change, you know. There are specifics at any given time that can change. And if you go back and look at history, even prior to deregulation, I think that it's a very unique situation.

You have to look at what's available, supply and demand any given time. Like, you know, we had over 100 degrees last week. Typically, if you go and look at statistics, you wouldn't expect that in May, you know. We look at statistics. We say, well, a couple of times it happens in June.

Most of the time we can count on 50/50 is either in July or August is about even. So it happened early. What you're going to see is are you going to use your hydro that day? Absolutely. Why? Because it's hot. Even if you're pulling on the capacity that you have available to you.

And if you have water behind it, even though it's energy limited, you're going to use it. So I think it's very unique and specific to a particular situation in any given time. And I don't -- you know, so in that way, I don't think it has changed, because nobody has told them the weather has changed. I mean it's been deregulated.

MS. GRIFFIN: Thank you.

PRESIDING MEMBER BOYD: Jim, I'd like to follow up on that a little bit. I'd like to praise Randy and PG&E for the operations of Helms during the summer of 2002, as every day we sweat whether the lights are going to stay on or not. And we're always relieved to see that you pumped up some water the night before, and down she fell again.

So that's the compliment. Now, the other half, as one who spent an awful lot of time prior to being a Commissioner reviewing hydro, and actually before the sky started to fall on us electricity wise, but after deregulation, some of us feel we did observe that the PG&E system was being run a little harder than it historically had been post deregulation.

And we did that in the context of the huge effort that was put into study the proposed sale of the PG&E hydro system. I don't have any hard data. It's just kind of a gut reaction. I'm not criticizing, it's just kind of an observation that has stuck with me.

I'm interested in hearing the fact that overall maybe it didn't change that much. Maybe others will have something to say later today.

MR. LIVINGSTON: Yeah. That 2001 period certainly there was multiple things going on, as we all remember. But also at the same time, it wasn't a very strong hydro year at the same time. And one of the things that certainly under the ISO direction on running Helms and in other areas we were trying to do during that period of time, just like we would under any electrical emergency, is make sure that the power was available at the time it was absolutely necessary.

I don't know that I see any real difference in overall reservoir levels or other things. Certainly, the DEIR had a lot of things in it. PG&E disagrees with the basic facts and conclusions of that document where flows happen and reservoirs stay up. The facts didn't match on it.

It was never completed. But certainly, from looking at the overall system, compared to history, I don't know that we've seen anything that shows any dramatic difference during that period of time than in years past.

MR. MCKINNEY: Okay. Thanks. I'm sorry, we're going to need to keep moving here. So maybe we can work your question in at a later session. I would like to switch gears a bit and we're going to talk -- and, again, thanks very much for our panel. It was good presentations.

I'm going to switch gears a bit and talk about hydrology, the snow pack and climate change. It is our very great pleasure to introduce

Mr. Mory Roos with the Department of Water Resources. Mory has been the chief hydrologist for the state for, what did you say, 35 years, 20 years, 45 years?

MR. ROOS: I've worked for the state for about 46 years.

MR. MCKINNEY: Forty-six.

MR. ROOS: Chief hydrologist, about half that time.

MR. MCKINNEY: Okay. He really knows our system. Again, he's with DWR. I understand he's retired and working part time as an annuitant. We're very privileged to have him here. And I hate to have to do this, but if we can keep this to ten minutes as allocated, and then get to our environmental panel, which hasn't even begun yet. We're going to try to do that before lunch.

MR. ROOS: Thank you. It's a pleasure to be here. And I think most of us have heard by now there's some very long range forecast of global warming over the 100 years that will be producing significant climate change.

Some of the more important changes would be temperature increases, possibly around three degrees Celsius, with a range of 1.4 to 5.8, according to the IPCC. That's the inter-government panel on climate change reported the year 2001.

The increase would raise snow levels and change the pattern of runoff from out mountain watersheds, thereby affecting reservoir operation, and also hydroelectric power generation. Other consequences would be sea level rise, possibly larger floods and more extreme precipitation events, and changes in vegetation and the water requirements of crops and of wildlands.

Today, our concern is the potential impact on hydroelectric power generation due to the anticipated snowpack changes as a result of warming. But I'd like to caution t hat one of the most important parameters in determining runoff and, therefore, water supply is precipitation.

And regional precipitation predictions in these huge general circulation models of the atmosphere have not been reliable, and vary greatly among the different models. Some models, such as the two that we used in the National Water Assessment of the year 2000 increase average California precipitation, actually increase it a lot.

Other GCMs showed drier results. Those are important because ultimately precipitation is the source of the fuel, in quotes, that runs our hydroelectric plants. And we see that now in the yearly range of hydroelectric energy production, which is probably about 15 percent, I guess, on the average.

But it can go from ten percent in a dry year up to maybe 30 percent in an extremely wet year. So even a five percent change and an annual runoff would have a significant overall effect. And currently we just don't know whether the future climate in Northern California would be wetter or drier.

One impact of warming is sure, snow levels in the mountains will rise and the amount of water store in the snowpack, in the snow covered area, will decrease. This just pictorially shows you, you know, what could happen. Current snow level would be something like that.

If you had a warmer climate it would move higher. And this is sort of looking pictorially at a Sierra watershed showing, you know, what it might be now for the average snow level, and what it might be in a warmer climate.

A reasonable estimate is about 500 feet of elevation change for every degree Celsius temperature rise. And there's a lot of studies that have used three degree Celsius as a 100 year projection bench mark. And that's probably a reasonable mid-range for a lot of these studies.

This is a 100 year projection. So that would mean a rise of about 1,500 feet in average snow levels. And this is a chart that comes from the Scripps people showing the results of using one of the GCM models out in different timeframes, eventually out to the right, you know, moving out to 20/90.

It's snow water equivalent. And the blue is in percent of historical average near what it is today. And as it gets progressively more red that means just less and less snowpack, water content. We made -- well, currently, or at least historically, the average April 1st, snowpack line is about 4,500 feet in the north, say around Shasta Reservoir, and maybe about 6,000 feet in the Southern Sierra.

We did some earlier assessments as a

department many years ago and looked at just the rise of 1,500 feet to see what the change in estimated snow covered area would be. This chart breaks it down into four of the hydrologic basins.

But the bottom line is it's about a 50 percent loss in snow covered area. Much bigger in the Sacramento River Basin than in the Southern Sierra. So only about a quarter of the snow zone would remain in the Sacramento, but about seven-tenths of the Southern Sierra.

And, you know, not all of the spring runoff comes from melting snow. In the Northern Sierra particularly precipitation in the spring does matter. And here's an estimate of what that could turn into in terms of the amount of April through July, which is our snow melt runoff.

Overall, this was a 1,500 foot rise. We were looking at about one-third of our historical April, July runoff being lost. It actually isn't lost. It comes out from the winter. But the bigger change is in the Sacramento Basin, about a 43 percent reduction, and not a big of an effect in the higher elevation, Southern Sierra, much less there.

Those are the very preliminary rough

results, but I think they've been pretty roughly confirmed by the newer work done by Scripps, which is Knowles and Cayan and others. That's just looking at the possible reduction in bar chart form.

Again, the bigger impact in the Northern Sierra, which is not as high, not as big as the Southern Sierra. Well, unless spring snow melt would make it more difficult to refill winter reservoir flood control space during late spring or early summer of many years, thus reducing the amount of water deliverable during the dry season.

Some of these lower early summer reservoir levels would also adversely affect late recreation and hydroelectric power, and possibly late season temperature, caused late season temperature problems for downstream fisheries.

Just to give you a sample, this is actually developed out of the Mokelumne River right in the middle of the Sierra. You know, seeing the monthly change. The historical pattern, it's very strongly snow melt driven with a piece there in May.

Under the modified runoff with a 1,500 foot higher snow level, assuming the same as historical precipitation, this change is to considerably more winter season runoff, and earlier melt, and a lot less during the April, July season.

When you run back through a reservoir storage system what you see now is, you know, being filled up from the snow melt. And then with the different pattern it tends to rise sooner in the winter, but you don't have as high. And during the summer months it's slightly lower head.

So a little bit less power generation. As I see it, there are really three elements of California hydroelectric power production. First is the run of the river power plants taking advantage of unregulated, or incidentally regulated, river flow.

The second is systems where flow is regulated by upstream power, where storage reservoirs, where flood control is not a requirement. And the third are our Foothill Reservoirs where power is produced more as a byproduct of reservoir operations for water supply and flood control.

It's difficult to say what impact the climate change would have in the first group.

There may be more usable water flow of a hydro in some months, particularly in the winter time. On the other hand, loss of the snow melt with its more even hydrograph or pattern of flow, may reduced the hours of suitable flow.

The effect on the second group of power houses where flow is regulated by upstream power reservoirs is likely to be small, such as the ones described to us by SMUD. Earlier snow melt on some winter runoff would just fill the reservoir sooner. And the operators would hold the water until the summer high electric load demand, and probably produce about the same power as now.

Assuming, again, no significant changes in annual precipitation. And I think others could tell you more about that than I could. The foothill group of major multipurpose reservoirs would be expected to see the major effects. And these are dams that, according to my tally, account for about 2,300 megawatts of capacity and generate about 7,000 gigawatts of average electrical energy.

Let me show you one other chart. This should have come in sooner. This is the Oroville flood control diagram. And what it really shows is during the mid-winter months we're supposed to keep 750,000 acre-feet of space. And this is gradually relaxed in the spring.

And the sample year, you know, shows that it almost filled that year in the spring. But if you have a much smaller snow melt it's going to be much harder to come up and refill the reservoir in the spring. And just tying back a little bit into is anything really happening?

These are all computer model projections. We've looked at the April, July runoff as a percent of water year runoff in the Northern Sierra streams. And it does seem like it's declining. And this current year was kind of a surprise in that for the first time the bar went up quite a bit above the lag.

But if you project that trend out of 100 years you'll come up with, you know, perhaps half of the lakes that some of the model predictions would be with three degrees Celsius. So the trend would indicate a slower, but presumably that's going to accelerate.

But I did an early study many years ago in looking at average of Lake Oroville Power. And the base study was this. And it was a very simple study, and I don't claim it's that's reliable. But you have two options, one is you try to maintain the water supply releases in the summer, which is the first one.

The other one is you back off and try to maintain a higher hydro. But I don't think that would be followed because we need the water supply too badly. But the net answer came out about seven to three percent loss in both energy and in June, July and August capacity.

So not large. And Lake Oroville is one that is most strongly affected by the change of runoff. Others I think would be less. Now, water supply of course is the primary purpose of the foothill reservoirs. But an analysis of the power impacted at each of the 12 major multipurpose reservoir project could be conducted.

And I don't think it would be that complex with average conditions. But average is tricky. The impacts probably vary greatly from year to year depending on the pattern of runoff. And some people have been doing a little work, Dr. Jay Lund at Davis has been looking at this a little bit.

But to my knowledge there is no

systematic study that made on the potential effect of hydroelectric power in California due to global warming. Our department is CALSIM. It could be a useful tool to estimate impacts of a change runoff pattern on the major Central Valley project and State Water Project Reservoirs.

The power routines in that model have not been used recently, but could be made operational again without a lot of work. And to do that though we would need to have modified river runoff scenarios developed by the academic community. And that is being planned I think now. But we don't have it at this point.

My conclusion is that the potential effect of a reduced snowpack would have a substantial effect on the foothill reservoir operation. And the largest effect is probably going to be on the Feather River above Oroville.

But based on some very preliminary studies, it would appear that there's a small reduction in hydroelectric energy and summer megawatt capacity at the multipurpose foothill reservoirs. Again, if the average runoff stays the same as historical.

And just to caution, again, the energy

production would be effective by a small change in wetness or dryness of the watersheds I think then snow levels. That's it.

MR. MCKINNEY: Okay. Thanks very much, Mory. You know, Mory is raising a set of issues that we are becoming, or we are of, and that are really I think going to raise a lot of kind of tough issues and discussions around the balancing, and how much is available for picking reserve capacity in the peak summer periods, the issues of ramping, being able to schedule power up and down, in stream flow rates and that.

And we're worried about it from an energy prospective. And it has obvious implications for managing environmental quality in the watersheds. I'm going to ask that we hold discussion on this topic until the afternoon where we do have more speakers scheduled on climate change and the effects on California hydrology.

I would like us to segway rather quickly to the government environment panel. If I could ask Ted, Jim and Nancee to kind of settle in up here. I see I'm schedule to do a brief presentation, which I promise I will make brief, keep us moving here.

Let's see, turning to too many things, I've neglected to load my presentation here. Does everybody have paper copies? This one is entitled CEC Environment Performance Report Findings on Hydropower? No. I apologize for that.

I'm just going to go through this very quickly. In the beginning of 2001 CEC has been directed to prepare an environmental performance report on the state's power generation system for the legislature and the Governor's office. It's a biannual report.

And we're supposed to cover status and trends and environmental performance, again, for all of the state's power system, including geographic distributions of environmental effects, air, water, wildlife habitats, toxicity, and then socioeconomic issues.

We've done one of these so far, and I just want to focus on what some of our findings were for hydropower, and for generation systems as a whole that use water for cooling or generations. So that would be thermal power plants, nuclear plants, and geothermal facilities.

Finding one primary biological effect from electrical generation development is lost in alteration of the aquatic habitats. That's both rivering, estering, and coastal habitats. Large portions of our hydro system were built in sense of ecosystems prior to the 1970's in the state and federal environmental statutes that now govern environmental regulation of major industrial facilities and power generation facilities.

The damage to aquatic ecosystems continues from power plant cooling and hydropower operations. We also noted that the new combined cycle natural gas power plants are marketably more environmentally efficient than pretty much anything out there.

And by that, I mean that they generate more power with less unit of environmental effect than pretty much anything we've seen, especially in the thermal sector. What we did in the 2001 report for hydro is basically try to canvas the literature and compile what we could.

There's a lot that we don't know about hydropower from a systems level. That's something that our sister agencies of the state and federal government are working to do. Our job is to really report on energy issues in the environmental effects of those energy issues.

We have a lot of work to do because there's just a lot we do not understand. There's a lot of information that has never been compiled in a way that we need it to meet our mandates for the environmental performance report, and now with the Integrated Energy Policy Report.

Here's some of the key findings: 60 percent of the California system, that's 8,000 megawatts, was built between 1920 and the '70s, as I mentioned, prior to NEPA Clean Water Act, etcetera, from the Sierra Nevada Ecosystem Project Report in 1996, done by UC Davis and the US Forrest Service.

Aquatic systems are the most altered habitats in the Sierra Nevada. Dams were cited as a causal factor in that alteration. According to the PUCs, the year 2000 draft and environment impact report on PG&E's application to value and divest its hydropower system, of the 26 hydro projects in that system nine were identified to have in stream flow issues, and ten have water quality problems, although that was not further defined in that report.

Sixty-six percent of California fresh water species are impacted by hydro development.

Dams eliminated 95 percent of the original 6,000 miles of Central Valley habitat. I think that's a US Fish and Wildlife study from 1998.

One of our key draft findings for the 2003 report, which I've already alluded to, is that we don't have a comprehensive systems understanding of hydro environmental effects in California. And in fact, nobody does. So that's one of our challenges and goals as we move through 03IEPR report cycle, and then into 05 and 07.

One of the things I was hoping to do today would be to talk a little bit about comparisons and contrast between our air regulatory system and our hydropower regulatory system. I am not going to take the time to do that now because I want to give my colleagues time to do their stuff.

But let me just say that it's very, very different, the structure is different, the process is different, and the results are different. And one of the things that we can say definitively is that while most of the states thermal generation units meet their air emissions regulatory standards at the state level, a good chunk of our hydropower system in California does not meet

California State regulatory standards for water quality and fisheries.

And I think Mr. Canaday and Ms. Murray will probably get into that some more. So with that I'm done. And I would like to turn this over to Nancee Murray and Jim Canaday. I'm going to go back there and introduce them.

We have with us today Mr. Jim Canaday who's a senior water quality -- senior environmental scientist with the California State Water Resources Control Board. Jim heads the FERK licensing unit. He's been working on hydropower issues for 20 years, and has over 20 years experience doing water rights, including the Mono Lake decision.

I've had the distinct privilege of working with Jim for about three and a half years now as part of our inner agency hydro team. I can say he is a state institution. The level of knowledge and experience of this gentleman brings and offers to the state, on behalf of the citizens of California, is just remarkable.

He is a walking store house of information on environmental science, aquatics, fisheries, hydropower operations, FERK licensing, you name it. He is just a tremendous asset to the state.

I'd also like to introduce Ms. Nancee Murray, senior staff counsel with the Department of Fish and Game here in Sacramento. This is going to be a joint presentation I understand. Yes. So I'll introduce both of them now.

Ms. Murray is senior staff counsel. I said that. She's a supervising attorney for the Office of General Counsel's Aquatics Team, which includes four attorneys and covers all legal issues involving inland waters of the state for the department.

She received her bachelor's degree from US Santa Barbara, and her law degree from UC Davis. She started out in private practice in Fresno working on water related issues after leaving Davis.

She also served as Assistant Attorney General for the Federated States of Micronesia before returning to the US and joining the Department of Fish and Game. Ms. Murray is also an integral part of our state interagency hydropower team.

And it's just another one of those

incredible state resources, really, really knows the issues, knows the law, and represents the department very, very effectively on behalf of the citizens of Natural Resources for California.

With that, Jim and Nancee, I'll turn it over to you.

MR. CANADAY: Okay. Thank you.

MS. MURRAY. And we were going to practice this a little bit at the nonexistent break. So what we're going to do is a little bit of back and forth. And I've been assigned the first slide. So the topic of this talk is the government's view on hydropower effect on the environment.

And certainly this is my view and Jim's view, and I'm with Fish and Game, which is within the Resource Agency. And Jim, the Water Board, is within CAL EPA. And we do share and want to emphasize today that different agencies in some ways different purposes, or specific obligations or responsibilities, but that we do agree on many issues in the hydro relicensing area, and help each other out as in making presentations quite often.

MR. CANADAY: We use motion to keep your

attention. We're here today to talk about water, in stream beneficial uses, and hydro generation, and the mix of those two and the balancing of those two. Not too long ago one would question whether we had enough water in California for the 21 mission.

But today we have 34 million people, and projected to be 40 million people in the near term. And the demand for water and the demand for energy continues. And so that is the crux of the problem. It's the paradox. How do you manage one and protect the other? So that's what we're here to talk about today.

MS. MURRAY: As the slide says, it goes without saying, water is essential to every aspect of life in California. And there are many competing demands for water in California. And the state constitutes and makes it clear that all water belongs to the people of California, not any particular company or species.

And the constitution also prohibits the unreasonable use of water. And what the department is doing a lot of the hydro relicensing is talking about the beneficial uses, and the unreasonable uses that there are. Okay. That the beneficial uses listed in the water code do include power generation.

And also, is cold fish water habitat and wildlife habitat. And as Jim McKinney mentioned, many of these projects were created before the recent environmental, since 1970s, '80s, modern environmental laws. And so there's, in our view, an imbalance in many of the older projects favoring hydropower generation to the detriment of wildlife habitat.

MR. CANADAY: We kind of restate or put into graphic prospective to understand the hydro systems of California. One only has to look at where our major rivers are and, therefore, that's where we have our systems that have developed the energy. One of the purpose of the slide is to show that if you look at the lands of where these rivers began and passed through, the lands are managed by the US Forrest Service.

And so our colleagues, federal colleagues, it's important for us to interact and work with them as we try to manage these resources in the future. The agency -- Nancee and I just want to talk a little bit about our agencies and who we are.

Quite often, most of you, because you are resource agency folks, when you hear DWR, Department of Water Resources, and then someone says the water board, you think we're the same animal. But we really aren't. We're in the California Energy Protection Agency, or California Environmental Protection Agency.

And we have a host of different agencies that manage different parts of the environment. And the two agencies that we're talking about today will be the State Water Resources Control Board, my agency, and our sister agencies, which is the Regional Water Quality Control Board.

Our mission at the State Board is to preserve and enhance the quality of California the quality of California water resources, and to ensure their proper allocation and efficient use for the benefit of present and future generations.

Just to give you an idea of some of the functions that we have, we work under federal mandates. The program that I work under is through authority under the Clean Water Act, the Federal Clean Water Act, and our State Clean Water Acts, and other kinds of laws, which Nancee is going to talk about in a minute.

But through those authorities we managed rogatory programs, established statewide standards, and water quality control plans through our sister agencies at the Regional Board. While the State Board has statewide authority, and that's who I work for, the regional boards, the state is broken into regions, or if you think large watershed areas.

And the responsibility of the Regional Boards is to develop basin plans. They're kind of our working Bible. Because the basin plans identify the various rivers, the beneficial uses of those rivers, and the standards that are necessary to protect those beneficial uses.

And so that's what guides us in our evaluation of hydro generation, or any other project on a river.

MS. MURRAY: And the Department of Fish and Game is within the resource agency. And I'm just realizing, we got this off our website, I'll have to tell them that (indiscernible).

MR. FRINK: And I'm very, very upset.

MS. MURRAY: I was just looking at it going, hmm, I'll have to let him know. But as you may notice, the first two, the Energy Commission and Fish and Game, are on the same page many times I'm sure. And the mission of the department is to manage California's diverse fish, wildlife, plant resources and the habitats upon they depend for their ecological values, and for the use and enjoyment of the public.

And part of that management is to help FERK better balance the fish and wildlife needs with hydrogen ration needs. We have, instead of nine, we have seven regions. And the significance really of this slide is just to show you that with some hydro projects are completely located within one region.

And that region is responsible for making decisions regarding that hydro project and any recommendations that might be made for that project. And there's some, but less than in other areas, oversight from headquarters in Sacramento.

You really need to look at that region that you're in. And Fish and Game participates in hydro relicensing throughout the state actively. And we do that as a trustee agency for Fish and Wildlife of California. The Fish and Game code specifically says that the DFG is the trustee agency for fish and wildlife.

And we have also jurisdiction through the California Endangered Species Act.

MR. CANADAY: With that we're going to move into more of the topic at hand, which is hydroelectric generation. And what we want to talk about is our similar roles and similar interests in protecting the public trust through out authorities, both state and federal laws.

And hopefully working together more often than not, and to achieving a common goal for the public in protecting the public trust. First of all, we'll give you a quick lesson in hydroelectric power. Water runs down hill.

And, therefore, that's all you need to know. It generates a tremendous value is that it moves to the turbines as it passes down to the low ends and out to the sea.

MS. MURRAY: And hydroelectric projects affect hundreds of waterways throughout the states. And there will be 46 projects in real licensing in a very, as hydro project go, short period of time, ten years. And projects vary in scope, as there are large projects.

Pam talked about the ERC project and the American. There's above the ERC there's EID's project, and below it is PG&E's project. So the American River is greatly affected by hydroelectric projects. Mokelumne River has a fairly large PG&E project.

San Joaquin River has a huge -- SEE's biggest project is on the San Joaquin. Pit River has -- and I never understood why it goes one, three, four, five. Whatever happened to two, it got inundated by three, four and five. And we will do a more specific example on the Feather River later on in the presentation.

And as you can see from this slide, the far left top most left, some of the projects are very small. This is a flume. One of the IDs projects, IDs project. It use to be a mining operation. Now it's being adapted for hydroelectric project generation. Flumes are greatly affected by mud slides and many other things.

And this particular is a problem for deer. The next one to rights paddle wheels, our little step up from the size of the EID. And down below it, getting bigger still to the left is, how would you say, it's twin nozzle pelton.

And to the right a very large

hydroelectric project. So they run the gamut through sizes, very small to very large.

MR. CANADAY: As we look at how we're going to deal with analyzing hydroelectric projects, it comes down to what we call the beneficial use concept. Nancee touched on and listed some of the beneficial uses there in our basin plans. Those are what we are supposed to reasonably protect.

And so simply under the beneficial use concept, all water quality problems can be stated in terms of whether there is water of sufficient quantity and quality to protect or enhance the beneficiary uses. And we make note that fish plants and other wildlife, as well as humans, use water beneficially.

And because of that, we have tremendous competition for the use of that water, whether it's for growing crops, generating electricity for in stream beneficial uses, or on stream beneficial uses. And that's part of our dilemma is how we balance all those different opportunities of the use of water.

And we do that through the FERK process, the Federal Energy Regulatory process. And as the projects are either licensed originally for 30 to 50 years, or like we're coming up with now are projects that are going to be relicensed for 30 to 50 years.

We have this process that has been joked upon already. It seems never ending. And I have a slide that kind of typifies that process. You know, the meeting was called to order to discuss the meat, and has been pointed out, there's no more meat. And the motion has been made to fight over the bones.

And in some cases it seems like that. But in recent years we've had a better dialogue with our colleagues in the industry, our colleagues in other agents, federal and state agencies, and certainly the public at large, the NGOs. And we've entered into different kinds of processes that we call collaborative.

And we've had some pretty positive outcomes. And so we're looking forward to stepping away from the old way of conducting business into the new way of conducting business.

MS. MURRAY: And some of what we do, the Fish and Game and the Water Board, in the FERK process is we participate actively, as I said before, in both the traditional, and now in some of DWR for example, and SMUD's, alternative licensing process.

We participate and comment, and study design field studies. We review and comment on those studies on the CEQA documents. And I'll explain more later that Fish and Game makes recommendations pursuant to a Federal Power Act Section 10(j). The Water Board does CEQA document preparations for its water quality certification.

And the water quality certification, DFG makes recommendations. My new best friend, Jim Canaday, makes mandatory conditions. And what we're all coming to understand is that there's really a lot of long term monitoring and reporting in this next round of licenses that, at least within the department, we're having a lot of discussion about the commitment to staff ongoing in the next license.

That in the last round you created license conditions for past and then you went on to something else. Whereas this time, there are adaptive management provisions in the licenses. There is an ongoing commitment that we need by management for staff.

And that is in this budget cycle, an ongoing discussion that we are having in making sure that we have the staff available, not only for the process, but prelicense, but post-license. In the Water Board you are monitoring -- that's part of your slide.

MR. CANADAY: While the State Water Board has a water rights function as it relates to the use of water for hydroelectric power, our principle authority in the relicensing arena is through the water quality certification that's required under section 401 of the Clean Water Act.

And it says that water quality certification program regulates any applicant for a federal license or permit that may result in any discharge into navigal waters or actually tributaries to navigal waters. And our 401 certifications contain mandatory conditions that FERK must include in the license without change.

And 401 also requires us to develop monitoring programs to ensure compliance with those terms and conditions. So to back up what Nancee says, as we go through this relicensing and the modern era it takes a further commitment of staff because it no longer is, well, here's your decision then you walk away.

Here's your decision and you become part of a working group with the utility and other players to move forward with the life of the license. So it's hard work and it is indeed labor intensive, or staff intensive.

MS. MURRAY: And as I mentioned earlier, Fish and Game is there not in issuing a permit or certification, but makes recommendations to FERK to adequately and equitably protect, mitigate damages to, and enhance Fish and Wildlife affected by the hydro project. And we commonly refer them to PM&E measures.

And pursuant to 10(j), section 10(j) of the Power Act, the FERK must adopt our recommendations unless it makes a finding that adoption of the recommendation is inconsistent with the purposes of the Federal Power Act, which gives us a little bit of a leg up on other non 10(j) agencies. 10(j) agencies tend to be the State Fish and Wildlife agencies.

I know park service, some of the national and federal agencies, too, but not anyone is a 10(j) agency. So it is something that we are -- it's not completely beyond them to find it inconsistent and to override our recommendations, but at least it gives us a process to go by in making the recommendation.

And then we also can call for arbitration regarding -- or call for a meeting regarding our recommendation. Important laws and regulations, the Clean Water Act. Jim mentioned Porter-cologne is our State Water Quality Act, Fish and Game Code. The basin plan really drive the water quality certification.

CEQA/NEPA come into play because both FERK in issuing its license, and the Water Board in issuing its certification comply with CEQA and NEPA. Federal Power Act in its regulations, that's what we're going through in these relicensing.

And ESA, the Federal Endangered Species Act, because a new license may trigger the ESA consultation, which drives many of the new relicensing provisions. The big picture, as Jim mentioned earlier, McKinney, the Sierra Nevada ecosystem project found that in California hydropower projects have profoundly altered stream flow patterns, timing an amount of water, water temperature with significant impacts to buy a diversity.

And according to Fish and Wildlife Service, dam construction has eliminated 95 percent of the original 6,000 miles of salmon and steelhead habitat in the Central Valley. And specifically, hydro projects block miles and miles of spawning and rearing habitat, slow fish down on migration while reservoirs harbor predators.

Peaking power operation often leads to the stranding of salmon reds. And this is most clearly seen in the Yuba River. And dams inundate habitat for amphibian species such as frogs and salamanders. And, again, using the ESA, or complying with the ESA regarding red legged frog, and the mountain yellow legged frog, and the inundation at these foothill reservoirs is a major issue at many of the relicensing that's going on.

So in terms of the big picture, many of the rivers were flatlined, or have been almost flatlined with the original licenses issued in the '40s and '50s that did not really consider fish and wildlife resources. The idea was you're going to build a reservoir and get as much power as you can out it.

Our goal, Fish and Game's goal, is to return as much as the river to its natural hydrograph with the high winter flows and the spring runoff, so that instead of a flatline release you get more of the natural hydrograph. And as we go into this next 46 projects we do have some different tools.

ECPA, the Electric Consumer Power Act of 1986 requires equal consideration of environmental values in relicensing and created this section 10(j) process I spoke of that requires consultation with State Fish and Wildlife agencies. And we are hopeful as we go into this next round of relicensing, not only SMUD has chosen the alternative licensing process, which goes into a much more collaborative process.

DWR has chosen that process. And that we can continue to work more collaboratevely to develop the information that's needed to issue a better license the next time around.

MR. CANADAY: So what I'd like to do briefly is take you through some of the resource issues that the state agencies and federal agencies look at as we go through this relicensing proceedings. Realizing that we're dealing with the science of uncertainly, because we're being asked to make conditions and approve project operations that are going to persist for 30 to 50 years.

And of course the state of our knowledge from the previous license, and our understanding of river function, has increased much like our knowledge in any other science. But nevertheless, there's still a lot that's unknown. So we still are in a need of data, and we still are in a need to follow these projects through their next life cycle, if you will, to make sure that we both produce power, but we protect the environment at the same time.

So some of the issues that we're dealing with, looking at historical data or unimpaired hydrology, what did the river run like? So we have a better understanding of the processes of the river without the project. Of course we do have the project there.

And so we need to look at the impaired hydrology. How does a river run daily, monthly, and maybe seasonally or annually to get an understanding of how that compares to how the river ran wild. We need adequate gauging so we have the data so we do understand how these rivers run.

And then if there are reservoirs, non run of the river projects, we need to understand how the reservoirs are operated. Is there a minimum pool? Are they completely drawn down? Are there seasonal -- or how the fluctuations occur seasonally, and how they may impact public trust resources.

MS. MURRAY: Just to briefly interrupt, part of what I said is changing is that I think before FERK would issue a license you have your terms and you simply went and operated your project. And there was not a lot of ongoing monitoring. So as we come to this round, yes, there's been a project for 50 years, but we don't have a lot of data.

And that is something that we are at a disadvantage at, and in going into the relicensing in many, but not all instances. And which will change the next time around because, as we said, we are all asking government for more monitoring in the next license.

MR. CANADAY: Yeah. Our goal is that at the next cycle, when I'm working on PG&E projects

50 years from now, that we'll have adequate data to understand what is the changes that have occurred. Let's see, the other flow related issues, we're interested in the flows that are necessary to protect in stream biological resources.

We're just starting to really understand how rivers function and how rivers work to manage the biota that is there. We need to understand the flows that are necessary for on water recreation. This is a new issue that I'll talk about in a minute or two where the Energy Commission is having a very important role in that endeavor.

Ramping criteria, you've heard something about the flexibility that's necessary for these projects to operate, but at the same time we need to understand and develop ramping criteria that also don't impact some of these other beneficial uses.

Run of the river projects versus peaking operations have inherent different issues that we have to deal with. And so we look at those projects differently. General water quality, the basin plan beneficial uses and their objectives, how can we reasonably implement those, and how can the project come into compliance with those if they aren't already?

We look at the historical background water quality to understand what the river would have been running without the project. We look at what the project with the project, then we look at the basin plan. Where are we? Do we need to step back in time. And in some cases that is putting more water back into the river and, therefore, a loss of a certain amount of generation.

We also have to look at what factors are controllable. In other words, we find impairments in our rivers that certainly aren't the responsibility of the generator. And we have to be able to tease that out so that they're not making in a sense payment for someone else's crime, or someone else's misjudgment.

So we spend a lot of time looking at that and trying to fit the person who's responsible. And then if they're a controllable factor apply that to the project. And that leads us to our major goal, and that's looking and understanding the ecological factors.

And we use fish as a surrogate, but

we're really talking about the whole river and its processes. And so as we try to understand these factors, we're collecting data to understand how all these factors interact. And part of that are things that are a consequence to the project.

And as we're talking about or hearing about climate change, that has its own effect that we have to be able to understand and recognize. A good example of a problem that we deal with, it's common in our rivers, and that's the problem with temperature. Many of our rivers were cold water rivers.

And the fish that were in these rivers, and we'll use trout here as a surrogate, have a range of preferred temperature, and they have a range of optimum temperature. But as a project or some sort of a (indiscernible) in the river, changes the temperature in the river higher or lower.

That has an impact on the bioda of the river. So in many cases we're looking at projects across the state where we see an elevation in temperature. And our job is to try to work with the licensee and develop ways so that we can manage that river and protect, or restore, or manage the existing cold water so that these river types of beneficial uses are protected.

MS. MURRAY: As Jim mentioned, we are learning much more each year about rivering processes and what are the necessary flows for channel maintenance, gravel recruitment, sediment budgets. And every river is different. So if we kind of feel like we've got it figured out in one river it is going to be different somewhere else.

We can use the principles, but how we -- what level of flow you need to get that channel maintenance, the flushing flows down on the Eastern Sierra, the exact levels will be different in the Northern Sierra.

But, again, timing of flows, it's the department's policy that we are trying to replicate the natural hydrograph and to insert into many of these licenses ramping criteria that would help decrease impacts onto fish and wildlife from peaking and other types of operations for hydropower.

MR. CANADAY: This is a very hypothetical river hydrograph. And the idea what we're trying to get at is when Nancee is talking about restoring a natural hydrograph, the river does its work in these peaks. And of course these peaks are valuable because they're the peak time opportunity to either store and generate later, or store, or generate as a run of the river.

And so this becomes the part of the problem of identifying how we can restore some of these functional parts of rivers. Because the red line, while that talks about instantaneous discharge, that was the way we managed rivers under the old license.

We set a minimum flow. We flatlined the river. And what we've learned since that time is that we have to restore to some degree these natural processes to allow the river to work, to allow the river to move sediment, flood areas, restore, repairing vegetation. And so this, again, is what we're working with with our colleagues in the industry to try to restore the functions along our rivers.

MS. MURRAY: And we're going to work through a specific example of the Feather River. And the picture is actually a fairly dramatic, although small, depiction of what a hydro project can do to a river, which is there's not a lot of river there. But there's a fair amount of hydropower project, probably at this moment the picture was taken.

So the Feather River has a number of hydropower projects on it, as you can see. All of the circles being some part of the hydro system that is completely owned by PG&E. And that is one advantage right now. I mean I under (inaudible) is down at the bottom. I haven't forgotten it completely.

But we see right now at least, even though a problem with this watershed, and the many licenses, many projects that it has that it is many different licenses that are not coordinated in time wise, they at least have one owner. And that possibility is there for the future.

And there is some possibility to go into the future and take those multiple license and try to get the expiration dates in a much more coordinated fashion. And even we talked earlier about controllable factors and contributing.

If there's a temperature problem one place in the Feather, if it is the same owner, you can work with that owner and have that temperature problem addressed beneficially up high that would then effect the other projects. This is my pitch for PG&E not to sell this project to piece mill.

So issues that we have seen on the Feather River, again, the first one, multiple licenses with varying expiration dates. There's a huge temperature problem in the middle of the Feather River system at Rock Creek Crest, well, that's affected by other projects higher up in the system.

Competing beneficial uses as the slide somewhat showed lake versus river Lake Almador is a huge reservoir at the top of the system. I didn't earlier note that it floods about 27,000 acres, which goes to the frog habitat type of -- to the meadow and made it a reservoir.

And there are, as we create in stream flows, there will be -- we need to balance the river recreation that has built up, or the lake recreation has built up around Lake Almador with the river recreation Jim alluded to in terms of the on water recreation being a new use.

That is the whitewater folks that we are doing some tests on how we can accommodate both whitewater and frogs, fish, and other parts of the ecosystem. And that would be the manufactured (indiscernible). And then understanding hydrologic variation and effects on the biological resources.

MR. CANADAY: So one of the things for me being here today is I want to pitch to the Commissioners the importance of the partnership that we have with the CDC. As Jim has already stated, we have been working with your staff on National Hydropower issues, and Mr. McKinney's done the omen's work in organizing and managing that team.

We worked with Mr. O'Hagan of your peer program in dealing with some funding of some things that we didn't have the money to fund, but they were critical issues. And through your peer program we've been able to fund that. The first one we did was a bibliography of the impact of temperature on aquatic organisms.

It's now being used across the country by resource agencies and consultants. So the value of that is immeasurable. Currently we're working with your staff because of one of the issues that's come up because of relicensing. And that is historically there may have been flows during the summer months that would have support on water recreation or whitewater recreation.

But because the project is there now, those flows are generating kilowatts. And part of our relicensing is to indeed look at that. And what are the opportunities to bring over short periods of time water back to the river so that that beneficial use can exist and be used by segment of the public that that beneficial use is very valuable?

The controversy is, well, what happens when you put that water back into a system that's evolved in a sense to not having that water in, and you're putting it in, I call it, manufacturing flows for short durations of time. And there is great debate amongst the scientist. There's debate even amongst ourselves within our agencies of what the consequence of that was.

And we certainly didn't have the wherewithal to analyze that. So we came to you folks, wrote a grant. And you folks supported that grant. And what we're looking at now is the ecological evaluation of hydropower pulse flow releases. And that also includes project operations.

But we're focusing on water recreation, on California stream systems. And it's one way that we're going to involve the scientist in looking at, you know, what are the real questions? What's the real data? Part of my job over the years in my experience in resource management has been there are four elements in resource decision making.

The first three are not in any particular order, but nevertheless they're the first three. And that's emotions, politics and economics. The last one, which seems to be the last one, is resource data. What really is going on? So my job is to take and go after that resource data, along with my colleagues, and to elevate that resource data up into that mix of the first three.

And if we can do that we'll have inherently wiser decisions by the decision maker. And so that's kind of our job. And this is going to allow us to address a very important aspect of that. And we do appreciate the Energy Commission's participation. We also, as we understandably are going to be taking away kilowatts, because in some cases we are putting water back into the stream that had formally, or would formally, go through a turbine.

Therefore, there is a loss of kilowatts, and we need participation of Energy Commission staff to better understand how that loss affects the state's ability to meet its energy demand, and the cost or consequences of that loss. So I'm here pitching to you that we need continued and actually enhanced participation by CEC staff because it's a very, very important role.

And as the questions get more complex we need folks to help us answer those complex questions. And you folks are dealing with the kind of data that we don't. And that's part of the answer. So with that, that's kind of the end of our presentation.

And I guess we'll take questions afterwards.

MR. MCKINNEY: Thank you very much, Jim and Nancee for a very informative presentation. I'd like to give Ted Frink with the Department of Water Resources an opportunity to describe the DWR fish passage program. And, again, as we're getting hungrier, the shorter side might be better than the longer side.

And I'm looking for Ted's bio here. Here we go. Mr. Ted Frink is a graduate of Humboldt State University with a BS in Fisheries Ecology. He's worked for the Forest Service and as a private consultant. He's been a DWR employee since '93.

He's worked in the Fish Protective Facility Section and is currently chief of Resource Restoration of the -- excuse me, chief of the Resource Restoration Section. Got it. Division of planning of Local Assistance, which includes: Fish Passage Improvement Program; Statewide Watershed Coordination Program, and the Urban Streams Restoration Grants Program.

And when I first heard that DWR had a Fish Passage Program I got confused when you said, you mean the old DWR Fish Blockage Program. No. There are new programs, new mandates, new missions at DWR. And I'm sorry, no offense to DWR staff here. But the change in philosophy funding and programs that's taken place within that particular agency is pretty amazing.

And I actually don't know very much about it. So I'm personally interested to hear what Mr. Frink has to share with us.

MR. FRINK: Thank you, Jim. Yeah. It's very interesting that the department has caught a lot of people by surprise in having what's been labeled a Fish Passage Program or a removal program when the department has strictly been on the other side of that.

Just so you guys know, this was a technical slide that helped focus, but I'm going to use it as encouragement for you all since we're this far into lunch. Thanks, Jim. And good afternoon, everybody, Commissioners and audience.

I'm very welcome to be here. Both Nancee and Jim brought up a good point that we are sister agencies with Fish and Game, and work very closely together. We have very, very many common issues that we do work on, aquatic resources being one of them. And even though we have different responsibilities, we do need to work together towards common goals for the state.

And with DWR's mission we are obviously supposed to be delivering reliable water supplies. But as well in that mission is responsibility to conserve and protect natural resources for the state. So Jim McKinney invited me to come talk to you folks today on hydropower and environment effects on fish populations.

And briefly, I'll be touching these topics here listed on the slide. I'm going to try and provide a perspective on the relationships of the native fish and hydropower in my presentation here. And I'm going to kind of pick up. I feel like I'm almost a joint presenter with these guys, even though they did theirs together.

My presentation will actually pick up from a number of things that that they presented from the big picture issues. So thank you, Jim and Nancee for that.

Hydropower dams in general have many benefits of course. There's the power benefits, flood control, recreation, navigation, water supply, and the obvious economic benefits from the develop all the way through the operations of such facilities. As well there are tradeoffs that do come with these developed facilities on river environments.

And those tradeoffs can look like alterations to the ecosystem. They have species impacts of course, river based recreation tradeoffs. And as well, economic tradeoffs in having those facilities on rivers. One interesting note that I found in presenting and creating this presentation was that there's an expected need in safety repairs in the future of about one billion dollars per year over the next 20 years just to maintain the existing facilities.

I'm going to try to put this all in perspective within the development of hydropower and dams within the state. The perspective on hydropower dams, National Inventory of Dams put together by the army corps of engineers and FEMA lists nearly 76,000 dams constructed within the United States.

And 2,166 of those are listed as hydroelectric facilities, which are about 2.9 percent of those facilities. There's an estimate on hydropower provides approximately ten percent of the total electric power for the nation, as well as coming from a hind center for the environment report.

As well as there's about 600,000 miles of waterways covered by reservoirs within the United States. So for California, what does that look like? We've got, according to our division of safety of dams within the Department of Water Resources, somewhere between 1,200 and 1,400 jurisdictional dams. That number varies depending upon which document you're looking at.

But when I pulled open our DSOD 1993 document it listed 1,222 jurisdictional dams. Those are not all hydropower. I've got too many moving graphics here. So within California the CEC lists 386 hydroelectric facilities within California.

And if you used our DSOD number as the number of large dams, and assume that those are representing all facilities that might have hydroelectric, that it would be about 32 percent of the facilities in California that their dams have hydroelectric associated with them.

So what we've observed in terms of (indiscernible) populations following this development over time in the west coast, there's been at least some level of research done and estimates of about 106 populations of some that have actually gone distinct along with Western North America.

And not all of those extinctions were due to developments and rivers and watersheds, but it's certainly one aspect. And we know there's definitely more that are contributing or compounding to these losses. We'll hear more about global climate change, which is one.

There's ocean conditions, which can also effect (inaudible). And then over harvesting of our fisheries in the ocean and a number of others. So just for a home example, for our historic of the spring run, chinook salmon, which is one of our listed species, this was the documented or researched distribution of fish within the Central Valley of California.

And this information comes from the Department of Fish and Game spring run status review, and the result and current spring run distribution salmon range. So you can see there's a significant reduction in range in the fish populations case.

And as well, Nancee had mentioned the reduction of all populations due to this, an estimated 95 percent of the storage spawning and rearing habitat for steelhead and salmon just in the Central Valley. As well there's somewhere estimated between 80 and 95 percent of average annual flow is diverted just in the San Joaquin River watershed as a point of interest.

Within the historical accessible river systems in California there's been an estimation that there was about 6,000 miles worth of river system available. But today there may be less than 300 miles actually available to the same fish populations.

So what is the perspective of dams in society currently look like? Well, there's an example of the current information that's coming out in a number of different venues. American Society of Civil Engineers are guidelines for retirements of dam and hydroelectric facilities.

Rivers and powers number exploring dams. The Aspen Centers publication on think tank. Essentially, Aspen Institute is a think tank and had a new -- brought together a group of folks to think about what do dams look like in the state, or in the nation, and how are they being considered for the future.

Hind Center did a similar type look at dam removals and the future of the nation. So there's certainly out there in the public a viewpoint of the opportunities for looking at facilities that are beyond their needs anymore maybe. I think Nancee as well mentioned that dams are the most common and widespread form of direct human control in the river and stream processes.

This was even under direct quote within the Hind Center report. So I'm going to quickly touch on hydropower and the effects that they have on changing rivers, both from a physical process and biological process' perspective.

Physical processes, hydropower and dams in general can effect hydrology, the flood peaks. Seasonal flow is both low or altered flow patterns, again, referring back to the flatlining of the rivers and the changes that hydro peaking or hydro facilities can make in even seasonal flow patterns over what would be naturally occurring.

Geomorphic processes, again, bed load transport structures such as dams and hydro facilities certainly interrupt those processes, both by capturing material upstream and restricting transport downstream in some channel, and in some cases.

And in the control of flows, also effecting the channel formation and maintenance activities of the river naturally, which then also has its links to the ecosystem and ecosystem functions of the river, and the biological processes.

So stream continuity is altered when you have a dam or some large structure in the stream as well, habitat fragmentation relating to disrupting the continuum that exists in the river ecosystem. And there's a concept developed by scientists called the river continuum concept.

So putting something that would disrupt those natural processes ends up fragmenting the habitat and creating different conditions. The lotic to lentic, meaning reservoir to a river type environment is one of the changes we heard Jim and Nancee talk about the temperatures are certainly in there, and how temperature changes have a significant effect on biological functions of a river.

And of course the habitat conditions resulting from you have habitat fragmentation or the resulting flows, changing spawning, rearing or riparian conditions altering flood plains even. So jumping from there, we know we have to live with facilities on our rivers there.

They're integral to our society and the functioning, the functions that we have right now. So there's definite opportunities out there, and approaches that have been taken for improving fish passage around structures and/or protecting them when fish are having to interact with these structures.

Fish screens and garden facilities have been implemented over time to help keep fish from entrained in the facilities, guidance. Some of you may not realize, but there's been research done on sound, use of light, bubble curtains as another aspect for actually deterring fish from entering hydro facilities or redirecting their motions up or downstream into more suitable or accessible areas that are safer for them in passing the facilities.

Fish ladders of course are also out there and available, and have been built in a number of locations. There's probably more that could be done. Fish locks and elevators, I think we have an example in the state of one or two of those. There's facilities certainly in the Pacific Northwest and back east where fish are lifted up over facilities, and essentially in an elevator.

The trap and truck is another operation that does go on in a regular basis. It may not be preferred in all situations, but sometimes that's what is available and most feasible to conduct around some of these facilities. And then naturalized bypass channels, within California and/or the nation these are a new type idea, but the type of facility has actually been implemented over in Europe in a number of cases.

And essentially, it's trying to use or create a natural channel that the fish are attracted into and are able to get up and around the facilities that may be blocking the natural channel. So this is just an example of one facility, natural bypass facility. The slight view that you see down below our picture is the turnaround for the channel that they created to go up and over.

The second facility to show that this idea is being implemented and thought about for even large hydro facilities. This is in Germany on the Rhine River. Anyway, up on the upper left side of the picture there is actually a drawing or design of a larger bypass channel that is going to be -- I don't know the status, if it's actually been built or if it's in the process.

Anyway, it's a large facility designed to bypass anadromous fish up and around the hydroelectric on a large river. So it's a feature that I think has some potential future to be thought of more seriously in the United States as an option when we need to keep hydro facilities.

Jim McKinney mentioned that I do oversee fish passage improvement program for the Department of Water Resources. And that program I'll just quickly summarize were part of Cal Fed system restoration program. So the activities of fish passage improvement are meshing with, and supporting, the record in decision for Cal Fed.

The fish passage improvement program purpose was to improve fish migration passage by modifying or removing structural barriers, and identifying those opportunities. Currently, we have just put out the newest bulletin for the Department of Water Resources bulletin 250 on the program.

And it includes inventory of structures, priority projects, habitat conditions, and specie populations. So it is available on DWR's website if anybody wants to go take a looks at it. It's out for public review for 45 days. So please go take a look if you have an interest.

As far as the inventory, we've conducted an inventory within the Cal Fed solution essentially. So the Central Valley out to the Bay Area have potential structures with potential fish passage problems. And most of those structures still probably need evaluation to determine what their actual fish passage ability or problem might be.

However, we were creating an inventory, at least as a starting point to work from. And we did this work in close coordination with the Department of Fish Game because certainly, as the Research Protective Agency of the Resource Agency, they have a lot of data that we were able to tap into, assistance from their staff and the regions.

So apparently for California, I just picked a few of the studies that are actually going on within the state. There's a list here, and I'll just quickly go through some of the issues with each of these projects. They currently have some ESA issue associated with them.

There's one of the other more common more issues between are sediment transport and disposal issues for control. And the public safety are all part of these facilities. So your dam is a historic dam in the Napa Valley. It's over 100 years old. It's earth filled dam.

And this is a picture the way it looked back in the 1950's. At some point it was a jurisdictional dam within DWR's responsibility and through some modifications of a spillway structure. It was taken out of jurisdiction. So it was no longer inspected by the department for safety reasons.

And currently, this is a view roughly from the same location of what that reservoir looks like. It's entirely full of sediment. So it provides no water supply uses or benefits as it was originally built. We are currently assisting the City of St. Helena that owns this structure with helping them.

And the corps of engineers look at opportunities to remove that dam. St. Clemente Dam on the Carmel River, their Department of Water Resources is working with the water agency that owns this dam. There's a number of issues that are associated with it as well, including it is full of sediment, and it blocks southern ESU steelhead from habitat upstream.

It's original concern was a dam safety issue. It structurally was determined that it wouldn't be able to maintain itself under probably maximum flood or earthquake conditions. One of the proposals is a staged notching of the dam down lowering, and to do that, in order to control the release of sediment stored behind the reservoir.

So sediment in that particular case is becoming a real significant issue. And most of these dams, the flooding and/or associated sediment, the distribution sediment transport problems, are key in determining what's feasible for these particular structures.

Searsville Dam is in San Fransiquito Creek and Palo Alto. Another dam is fairly historic, been there quite a while. It's by Stanford University. Again, a sediment problem. It's nearly full of sediment. And it's causing currently some flooding on properties upstream of the dam.

They have completed sediment transport study of this structure and found that over time the sediment stored behind could be distributed downstream with little increase in flooding. However, there's other structures downstream of this facility that restrict flow in the river.

And, therefore, this structure isn't

going to be looked at real soon as removal opportunity, because of other flooding issues downstream that are going to be taken care of first. Marilija Dam on the Ventura River, another big one you've probably heard in the news.

MR. MCKINNEY: Excuse me, Ted, if I could.

MR. FRINK: Sure.

MR. MCKINNEY: I saw that you had Englebright in there. Maybe you could focus on that for the dam removals, and then kind of move to wrap up.

MR. FRINK: Sure, sure. Matilija, same thing, we've got sediment problems there. Englebright Dam is one of the few hydroelectric facilities that is being considered as an option. The driving force behind Englebright considered is really looking at whether it makes sense to get unambiguous spring run salmon and steelhead up above Englebright Dam.

And so Cal Fed is supporting a number of studies to look at the habitat conditions upstream of the dam, sediment problems, issues with mercury, and to evaluate those conditions and see if it makes environment and socioeconomic sense to actually think about passing fish over and around, or removing Englebright Dam entirely, all to benefit and try and recover, assist in the recovery of spring run salmon.

Without studies currently been funded for a number of years, for a couple of years, they've got a lot more studies still to go. And they're looking for additional funding to continue to the work that's being done. This has been a very -- after a rough start, the program has had quite a good success in getting stake holders participating and supporting the whole process to look at what might be done for the Yuba River in this case.

So hydropower and fish passage use that are out there, risk assessment and cost benefit obviously, ecosystem restoration versus power needs are going to be something to be looked at. Relicensing of course is our one opportunity for reoperation conditions, as we heard Nancee and Jim talk about, and mitigation opportunities.

Again, water quality and quantity, the in stream flow protection for biological needs and others. Sediment and transport, whether you need to deal with dredging to maintain reservoir capacity, toxic residues within any sediment stored behind any reservoirs and/or just dealing specifically with the volume of sediment that may be stored at some point.

Of course public safety and whether dams have become obsolete, for that reason for being, as well as economic and (indiscernible). Are they no longer providing the economic benefits that they may have originally been provided for? So that's the end of my talk, although the beginning of maybe a new future here.

Thanks very much for letting me speak to you today.

MR. MCKINNEY: Thanks very, Ted. That was very interesting and very informative. I would like to Chairman Keese or Commissioner Boyd if they have any questions for our panelist today?

PRESIDING MEMBER BOYD: I have a comment, not a question. This was dejavu for me a little bit. It was my tenure at the Resources Agency when we created the inner agency hydro group. And as I look around the room there are lots of former associates of that group. And I'm glad to see you're still doing your thing.

And I appreciate the fact that this

agency now is a much more active member of the activity, and is going to financially support some of the work that you're doing. So just a general comment, observation.

CHAIRMAN KEESE: I think in the interest of lunch I'll hold off. I'm going to be interested to see how we bring this all together before the day is over I trust.

MR. MCKINNEY: It just depends on your definition of when the day ends. Okay. I do see that the Forest Service regional hydropower systems team is here. I would like to acknowledge their presence, perhaps at the beginning of the next session. If you have anything you'd like to add to this governing panel's presentation I'd like to give you the opportunity to do so.

With that, unfortunately I think we're going to need to break for lunch. I propose we reconvene at 1:30. It will be shorter lunch break. But that will really help us kind of move through the afternoon sessions. I think there is a menu and directory of local lunch spots out there in the front. So please have a good lunch and I'll see you back at 1:30.

(Thereupon, at 12:50 p.m., the workshop

was adjourned, to reconvene at 1:30 p.m., this same day.)

AFTERNOON SESSION

MR. ALVARADO: Chairman Keese, should we wait for Commissioner Boyd?

CHAIRMAN KEESE: No. Let's go.

MR. ALVARADO: Okay. Well, I think everybody already knows Jim, but maybe I can take this opportunity to give a little bio on Jim. Jim is an environmental policy specialist for the Commission, who's been working on energy and environmental issues, particularly on hydro.

He's also on loan to the Resources Agency as a hydro policy advisor coordinating statewide work at the National State level on hydro issues. Before Jim came to the Energy Commission he has two years work with the EPA in Region Nine Water Division.

Jim's also worked with PG&E for nine years. Mr. McKinney has a Masters in public policy from UC Berkeley Golden School of Public Policy, and also has his bachelor's from UC Santa Cruz.

MR. MCKINNEY: Okay. Thanks, Al. And we do also a little bit of introductory work here. The focus of this entire day is to really help us understand what are the broad, you know, energy production, energy management issues associated with hydro? How is that important to the state in meeting, you know, liability and cost of goals.

The second panel was really intended to present, this is government's view of the environmental effects of hydropower development and operations in the state. And this third section is intended to really start digging into what's going at the margin.

When we're balancing hydropower operations, generation, all those things that hydro is really, really good at, a really vital part of our state's resource mix, what happens when you look at the environment effects, which are profound, widespread, nonmitigated in many instances.

What happens there at the edge in terms of the numbers? So that's something that I'll be speaking to. Dr. McCann, John Kessler, myself again, and then our folks from Pier II. And then at the end of the day we'll have a good round robin forum with some of the key stake holders involved with hydro licensing.

As you'll see from my presentations I'm a ludite when it comes to powerpoint presentations, but I do have lots of numbers that I want to throw out at you. The presentation for this part is what are the energy effects of hydropower for this part is what are the energy effects of hydropower licensing in California?

And it's a pretty basic question. As a public policy analyst, I think the decision makers i serve should really know what are the facts. We don't know the facts. I was surprised to learn that nobody has ever asked this question before, or done kind of the root of entry investigative work to learn this.

We have commissioned to study ICF, began that, and then Aspen finished it up. So that's what I want to speak to in this little presentation. We have no objective document of study of what the energy effects are from licensing in California, nor do we have a rational systems, although understanding of the energy and environment trade offs associated with relicensing.

This is a big deal because decisions are being made in real time at the state level, at the project level, and at the national level on what should this balance look like, and what should the governance and regulatory process look like for this important energy resource.

In California, 37 percent of our system, that's about 5,000 megawatts, and that's about half of what is the non-federal program, they're going to be relicensed by 2015. And that translates to 44 FERK licensed projects. The national level, 50 percent of the national non-federal system, or 30,000 megawatts will also be licensed, or relicensed by 2015.

And this is an active topic of debate with the FERK NOPR, which is the notice of proposed rule to revise hydropower licensing procedures at the national level. It's a hot topic in the Federal Energy Bill right now, specifically with the Barton Amendment.

We had a little bit of information, the FERK 603 report issued a couple of years ago, documented nationally at 1.6 percent decrease in production offset with a four percent increase in capacity. I was looking for some definitive statements from the producer sector and could not find any, but what I've heard antidotally is a ten percent losses in energy production.

What we did was survey the most recent

14 projects licensed or relicensed in California since 1992. Eleven of these have final license terms, three have final terms, but no license per se. This sample totals 567 megawatts and name plate capacity.

Two of the projects were about 200 megawatts. The rest were quite a bit smaller ranging from below five megawatts up to 20 or 30. Method and caveats on this, we gleaned this information by reviewing the NEPA record for these projects. That includes draft, environmental impact statements, environment assessments, FEIS, and then other materials available through FERK.

I want to thank the US Forest Service in particular, and also the State Water Board for making their repository available to us, and of course the FERK library in San Francisco. These numbers may not include the final changes and conditions.

And this only gets that name plate capacity in gross annual energy changes. When you really start digging into hydro, I mean the action is what's happening seasonally, monthly? Are these run of the river projects? Are they storage projects? Are they dispatchable. That's not in the record yet.

And that's one of our tasks ahead of us. I don't know how well you can see this, but this is the sample, again, from '92 to about the present. Again, about two projects, around 200 megawatts. Those are PG&E projects at Mokelumne and Rock Creek Cresta. And, again, the rest are quite a bit smaller.

What did we find out? Five of the licensees chose to increase capacity at the time of relicensing. So we saw a modest, you know, nine megawatt capacity increase. That was 3.6 percent of this particular sample.

Let me state that licensees often take advantage of FERK relicensing to repower to upgrade their turbines because they can take advantage of the permitting and relicensing work that would need to be done otherwise.

Production changes can occur from changes in in stream flow levels, ramping rates, or other environmental mitigation. The results for this sample, we cited 5.26 percent decrease, an average annual energy production. There you can see 147 gigawatt hours was the difference.

Back to the table this time with some

numbers added in on a percentage basis, you know, it important, you know, to make sure we talk in percentages, absolute numbers, what have you. The larger projects tended to show the smaller changes on a percentage level with some of the small projects had very, very large percentage changes.

Let me try to interpret this a bit for you and put it in perspective. We've got about 14,000 megawatts, name plate capacity in California. We've got about 53,000 megawatts total capacity in the state. Generally, repowering to increase generation efficiency is desirable.

We like to see that with all the generation units that we've got out there, regardless of the fuel source. The small capacity increase here is really not significant one way or another when we're thinking about local and state, and regional reliability.

In terms of energy production, we average a little over 37,000 gigawatt hours a year. That's about 15 percent of total demand. I don't think it's been said -- well, it's been said many times, but that number varies tremendously from nine percent to 30 percent of the state's electricity consumption, with long term average 15 percent.

Again, 147 gigawatt hours really doesn't affect reliability or supply demand balancing forecasting at any significant level. Just another point of reference, average daily summer demand is about 700 gigawatt hours a day.

And I think it's always important to remember when we talk about energy losses from relicensing that relicensing creates environmental benefits and provides an opportunity to do some of the restoration work that our colleagues from Fish and Game, the Water Board and DWR, who we're talking to this morning.

This particular final report will be out in July. I asked members of our audience, the producer community if you have comments, questions, clarifications or updates on information in this little report, please provide it to me. We want this to be accurate and objective, and be a good part of the record.

Future investigations on this particular subject, which is what's the energy penalty from relicensing both at the state level and nationally, is we really need to look at, you know, changes in peaking reserve capacity. What's going on there?

That's really where the action is, in the summer when the peaking reserve attribute of hydropower is most desirable for reliability purposes. Water variance, again, I think the speaker from SMUD said today there's no such thing as an average water year in California. And that's a statistical number.

This stuff varies all the time. So we need to account that. We also need to build a summary of the environmental changes associated with relicensing. I wanted to just mention very briefly an order that the FERK issued in March 2001. It was called removing obstacles to generation in the west.

The objective of that order was to try to help us get through the power crisis. The Office of Energy Projects took a look at hydropower issues. They determined that there were 200 projects in the Western System Coordinating Counsel with about 21,000 megawatts of capacity that were subject to operational constraints, quote, unquote.

We call those environment mitigation

conditions. They all run in the same. FERK urged utilities within WAC, we now call it WAC, to examine license conditions and identify opportunities to relax environment standards, and increase energy production. Again, with the goal of trying to elevate the energy crisis that we had in the west.

This got us all very excited in state government. Six projects were ultimately submitted for review. The total energy production change from those projects would have been 550 megawatt hours increasing daily production.

And then that would have been a six-month period under which they could have done that. So we would have gotten a total of 38 gigawatt hours from June to December of 2001. Again, for reference, average daily loads in the summer of July it's 700,000 megawatt hours, or 700 gigawatt hours. It's 721 in August.

So 550 would have been a .08 increase in daily production. The State Environmental Resource Agency have a lot of concerns about this particular proposal from FERK. As has been referenced, 2001 was a dry year. That meant that the streams and river ecosystems were already distressed.

It was also a good year for returning some (indiscernible) because we had very wet years prior to that. Salmon live on a four-year cycle. You get good productivity in a wet year. And then they come back looking for some place to spawn. And if it's a dry year that creates problems.

If it's a dry year, and you're trying to tweak more energy out of a system, an energy system, that creates even more problems. Minimal power benefits, that was one of our responses to FERK from this proposal. We did review all of these. Department of Fish and Game and the Water Board took the lead in reviewing these proposed changes.

Ultimately, two were approve with a total increase of 90 megawatt hours. That's it for that particular presentation.

MR. ALVARADO: Thank you, Jim. For the next topic, which will be hydropower economics and relicensing effects on cost production, it's going to be a tag team effort. We have Dr. Richard McCann and John Kessler who's going to be giving a presentation.

Dr. Richard McCann is partner in a

consulting firm, MQ. He has worked on California's resource management issues, and energy, water, and quality since 1985. He has a doctorate in agriculture and resource economics from UC Berkeley, and Masters in public policy from the University of Michigan.

John Kessler has worked in the hydro industry in the utility, public, and private sectors. And now assists regulatory agencies in the evaluation of projects. John provides a practical insight with his direct O&M construction and rogatory compliance experience.

So Richard.

MR. MCCANN: Thank you, Al. I've been watching this mike, and I've decided you either have to be exactly eight inches or away or you have to swallow it.

The study that we've done here and that we're going to talk about has not yet been integrated with the rest of the Aspen work that was done under subcontract with Aspen. And John Kessler compiled many of these numbers. He's going to talk specifically about a case stay looking at the El Dorado relicensing case.

I'm going to present some numbers based

on the O&M cost and revenues, or opportunity values, that are related to hydropower plants, and how that all fits together in terms of cost versus potential margins that you can get out these power plants. And then finally, cover issues related to decommissioning, a brief overview of that.

So with that, I want to just look at that we're basically looking what is the economic margin for these power plants before and after relicensing. What you have beforehand is historic generation, revenues, cost, O&M cost, capital and debt service cost, other services such as water delivery or recreational services, and environmental values, recreational values, species maintenance, that sort of thing.

And then you want to look at this afterwards looking at what are the projected generation revenues and cost. What are your expected capital and debt cost in the future? And then cost related to developing the application, negotiating the application for relicensing, the implementation cost related to relicensing, how other services, again, are effected, recreation, water services.

And you're going to have some trade offs in recreation for example. And then the environmental values. And so with that, I want to move to looking at how we did this comparison. First off, we want to look at the revenues or opportunity values from generation.

And what we looked at is -- I should back up for a second and say that the projects that we looked at was a set very similar to the Aspen set, the set that Jim presented, which is projects that have been relicensing or are about to enter relicensing in the very near future, so that we have basically a ballpark figure that we're dealing with and looking at in this review.

We basically took the 2000 year hydro year because it's a near average condition. In California, and most of the facilities, were running between 90 and 100 percent of normal, or average water conditions. The problem with using 2000 is that from June to December those prices are probably not representative, as an understatement.

So basically we created an overly price series. We took the January to May 2000 prices, and then took the June to December 2001 prices and created an overlay in order to get an approximation of what you might expect in terms of revenues. Now, for some of the utilities or cost of service, those prices actually represent opportunity values.

That is that if they didn't -- they weren't selling power at that price they were displacing power that they would have to purchase for their customers at that price. So basically you can look at it as even though they might not be bringing in those kinds of dollars, they were avoiding having to spend those kinds of dollars.

And so from an economist's standpoint, there is no difference between revenues and opportunity values. What we found in looking at this analysis that was for run of river plants that were not selling ancillary services, that they were typically collecting about $30 to $35 a megawatt hour.

Or that translated to about $150 to $180 per kilowatt year. And I'll explain a little bit later why we used the kilowatt year basis. That has to do with comparing to relicensing cost. For power plants that provided ancillary services, those plants typically added about $10 to $35 per megawatt hour, on top of the energy price that they were receiving.

And for some of these facilities it was up to two-thirds of their revenues were coming from sales of ancillary services to the ISO. And that translates to about $30 to $200 per kilowatt year, depending on the power plant. Now, the next question is, well, given these revenues, how significant are operating and relicensing cost compared to these particular hydropower plants?

We went through FERK filings and through some of the utility filings for Edison and PG&E. In looking at that, we found that for O&M cost that the large power plans typically had O&M cost of $2 to $7 a megawatt hour on average. But that for smaller plans that were isolated from a larger system, that the O&M cost rose to about $10 to $15 a megawatt hour.

Now, these cost don't include capital and debt financing and some of those other cost. But I'll talk about that in the next set of tables, how we address that. Then there were also -- we looked at relicensing cost. Now, the complete set of relicensing cost -- we don't have a complete set of relicensing cost developed as of yet based on the documentation that we have.

But from the survey that we have done to date, the application cost typically falls between 15 and $50 per kilowatt. And for most of the projects that is a pretty narrow range. Now, there are several projects where we saw cost of $150 or even $340 a kilowatt, including the El Dorado project, which John will talk about in just a moment.

And so what we found is that for very small projects the relicensing cost could be quite significant. And for the two projects that we had compliance cost for, Mokelumne and Rock Creek Cresta, the compliance cost were about $3 to $10 per kilowatt year. So that was -- that's not a capitalized value, but that's how much it would cost per kilowatt year.

Next I'm just going to tell you these tables are in there. You can't read them I'm sure from out there. And what we have here is this first table compares the O&M cost for each of the individual projects to the revenues that we calculated based on the methodology that I described earlier.

And you'll find that in general for the large projects, the O&M cost fall into this $2 to

$7 megawatt hour range, and that the revenues are substantially higher. You would expect that the difference between the revenues and the O&M is the amount that can go to recovery of capital and debt service, and other fixed cost in the system, which we have not accounted for in the O&M.

But it does appear that there's a pretty substantial margin for the larger projects between revenues and O&M cost at present. The first sheet is showing PG&E. The second sheet is showing mostly Edison. We have numbers there for DWR, El Dorado, and SMUD's UR project as well.

The NAs indicate that in general we don't have data on those points yet. And then the second set of tables compares hydro relicensing cost and revenues. This is based on relicensing application cost in most cases, Rock Creek Cresta and Mokelumne, which are shown in italics.

Those are current mitigation cost, post relicensing. We need to try to make sure that we have a complete set of cost as one of our next steps that we have to do on this. But you can see that one of the things is that the revenue numbers are in kilowatt years. And the relicensing cost themselves are in dollars per kilowatt.

So that what you would have to do is either capitalize the kilowatts per year number, or basically amortize dollars per kilowatt in order to get comparable numbers. But one of the interesting things that's here is to see that the relicensing cost basically can be recovered in less than a single year of revenues from most of these power plants.

On the next page there's Edison. And what's interesting here is there's actually two Edison projects, Portal and Verrel where the relicensing cost are actually quite substantial, even though the revenues appear to be sufficient to cover the relicensing cost. In these cases those cost are quite large.

And then El Dorado is shown there with $340 a kilowatt are also substantial cost. And with that I want to turn it over to John to talk about El Dorado specifically, and the relicensing study that they did.

MR. KESSLER: Thanks, Richard. The El Dorado project, and it's just recently, is still undergoing its relicensing. I think of it personally as a success story partly because of the comprehensive environmental improvements that have been put together by the Resource Agency, the interested parties, and the timeframe in which this was accomplished, which is less than five years.

The licensing process began back in '98, and here as of April 2003 there's a comprehensive settlement agreement for the project, which has been submitted to FERK. And FERK currently is completing its final DIS combine EIR document for the board to certify its 401 from.

In the district, the El Dorado Irrigation District, is expecting a license order sometime around the end of the year or early 2004. If you look back on other histories of relicensing, Rock Creek Cresta, some of those have 20-year timelines. So FERK and the agencies are really I think expedited their process to bring this forward.

But the flow studies for El Dorado were -- Jim Canaday had talked earlier about developing unimpaired flow data versus regulated flow data. And in the case of El Dorado, the '72 to '96 timeframe, and just to look at the generation effects of the before and after relicensing, there's two tables here, the top table is the generation numbers.

The bottom table are the resulting change in revenues themselves. And the second column in terms of gigawatt hours annually produced by the project, the existing condition is about 106 gigawatt hours. And by implementing various tears of the agreed to environmental improvements to the project, the first of those are some new restrictions or lake level criteria for the reservoirs.

The second are some minimum flows below the reservoirs. Lastly, are some minimum flows and some bypass reaches below the primary diversion dam near Kyburz, as well as some tributaries that feed into the South Fork American, and also a diversion to the El Dorado Canal.

But accumulatively we see a reduction about 14 gigawatt hours per year is what's projected, the before and after case. The other columns, the third, fourth and fifth respectively demonstrate the individual increments of reduction. The fourth column is the percent of existing total reduction in gigawatt hours.

And the last column is to the extent

that there's a reduction of 14 gigawatt hours per year, what percent each of those conditions make up that total of 14 or so gigawatt hours per year. The bottom table is in a similar fashion represented in dollars.

And the bottom line is the district is projecting to see about a half million dollar decrease in its generation from about 3.5 to three million dollars per year in revenues. Which isn't a sizeable decrease when you think about the environmental enhancements that have been made with this project.

Just to look at the new license conditions, and this is really typical of many of the other larger projects that have recently undergone settlement agreements and are about to receive their license, like Mokelumne and Rock Creek Cresta. The issues are very similar, but also site specific.

For once, a new lake level criteria has been established, which improves the recreation opportunity. Some of you (indiscernible) by the Kirkwood area. That's really a vastly valued area for both winter, and summer activities, improve aquatic habitat, the new stream flow criteria.

And there's specifications for minimum stream flows and more (indiscernible) than the previous license ever had. Pulse flows, Jim had talked about the need to mimic the natural hydrology and allow restoration of transport in natural river processes.

So these pulse flows will allow those peaks to occur during the times that they would naturally occur as a result of releasing higher flows on the reservoirs. There are several recreation facility improvements. These include a new boat ramp at Cables Lake, campground access improvement at Cables Lake and Silver Lake, and white water access improvement along the South Fork American River.

Fish (indiscernible) are a plan for two the tributary stream diversions, that includes Alder and Carpenter Creeks. The primary diversion dam on the South Fork American was screened just a couple years ago as part of rebuilt after the '97 floods.

Another aspect is the public information system. This is going to be two-fold, one access will be via internet, the other via telephone. But this will be tied to the district's data system, the real time operational hands on monitoring system, which will provide actual day's data.

So where it says boaters, can I go out and drop my kayak in the water, or can help fishermen that want to know if the flow is low enough that I can wet my fly, those kinds of things. Extreme restoration in previously scattered regions, there's some areas, examples below the Cables Lakes spillway where the channel can't really support the flows that have been released there over time.

And so they're actually moving to release higher flows into a different outlet, a main outlet of the dam that goes down a natural channel, rather than a manmade channel. And this will improve restoration of the extreme reaches. Sensitive species, fish and water quality monitoring, this is something that for example foothill and mountain legged frogs are closely being monitored.

There's a number of various environmental protection plans that will apply not only to future construction. And lastly, ecological resources adapt a mansion plan. And what that does is it provides for ongoing monitoring over the term of the license.

It allows for adjustment in the actual criteria constraints that the project operates over time in order to sense what's going on ecologically and all through the operations within certain boundaries, in order to provide that balance of power production and water supply, and ecological benefits.

The last slide just gives an overview of the bottom economics of before and after. The first line shows that the generation on an annual basis will change from about 106 gigawatt hours per year to about 93. O&M cost are roughly the same, but there's actually about $200,000 per year increase.

This is primarily because the licenses are a whole lot more complicated than it was previously, and it will require more license administration on the part of the district, as well as more hydrographic work to support more stream gauges in the field as part of monitoring the project.

Capital will roughly stay the same at one to two million a year. There were licensing application. In this case it cost about 6.8 million dollars to date. The implementation of all the license conditions is a rough number at this point, a ten to 20 million dollars.

And that's subject largely to weather or not the district is successful in securing a Department of Boating and Waterways grant for a new boat ramp at Cables Lake, which they will be actively seeking. As far as adaptive management, under administrative just to coordinate there's an ecological resources committee that will be meeting on a regular basis to monitor reports and activities related to the project.

And there will be time committed to for that endeavor. The overall bottom line is that existing conditions for their licensing, the project was projected to probably see net revenues on the order of about $600,000 per year. After implementing these conditions the projections are probably operate under its current revenue stream at about $600,000 at a loss per year.

In the case of PG&E, Randy is probably thinking this is a great deal for PG&E to divest itself, and feels even more confident in that decision of years ago. From the standpoint of the district and water districts in the state, this isn't the only consideration in owning and operating a hydro system.

For this particular district this serves as one of their primary water supplies. It serves to provide them in the driver's seat to have that as managed, and how to control cost over time. And they have the ability to augment their revenue stream with water rates in order to help offset this projected deficit compared to some conditions.

The alternative for the district in this case as that should it shut down the power operations it would still incur nearly the same operating capital expenses to get its water supply delivered to itself, because it's a 22 mile open canal system, upper lakes. And the cost of production is primarily dealing with the pen stock and the powerhouse, which is a very small increment, ten, 15 percent of annual cost compared to total project.

So there are other districts in the state that have the same perspective. And I think from the standpoint of this is a win/win for them. It's a win/win from the standpoint of the agencies and was accomplished. And I think also kind of follows the templet that was developed for Mokelumne and Rock Creek Cresta is likely one to be carried forward with other projects. Thank you.

MR. MCCANN: And with that I'll just reiterate some of our preliminary findings from the analysis we've done to date so far. As John pointed out, most of these facilities are multi-use facilities. And so they have a number of values and constraints that are involved with them.

For many of these projects they have large margins of revenues over operating cost, and that's what we generally found. But the other interesting thing to find out was that the relicensing cost could typically be recovered quickly by many of these projects. That they were relatively small portions compared to their revenues.

And the other thing is that we believe that further analysis can be done with the available models. There are various models out there that we know can be used to evaluate these particular projects, and explore these issues further.

I want to move on to covering decommissioning issues as well, just an overview. As Jim pointed out when we were talking about this, this comes from a resource economist point of view rather than from the Energy Commission point of view. So it's a more holistic look at this issue.

And that's why I want to start with the fact that simple comparison of power revenues against fisheries or other environmental values is not the appropriate way of determining decommissioning values. And that's because projects are multi-use. You've got other things that you have to deal with, flood control, water supply, recreation.

And also when you were talking about decommissioning there are going to be tradeoffs in many cases between recreational and environmental values. There are going to be fisheries in reservoirs that will be disturbed. There will be lake boating, which will be removed in exchange for whitewater recreation.

And that there are -- however, there certain projects that have high cost relative to power revenues, and those can be candidates. And that relicensing cost may make those projects even more likely to become candidates for decommissioning. Just basically, I'm not going to go through this point by point.

But it's a framework for how to approach a decommissioning analysis. First, identifying what your expected environmental benefits are from the decommissioning action. And then clearly identify what the current services are. They are being provided by the particular facility.

And it's surprising that how much disagreement you will see about each of those two categories from the various parties that talk about these issues. Then you want to look at what are the cost and benefits of each one of these services, including looking at alternative power economic replacement cost, water delivery values, which is sometimes different than the revenues.

For example, we came across this in Potter Valley where the water that was being delivered to Anderson Value was priced at a very low value, at a very low price. But the value, agriculture value, was close to $200 an acre-foot. So that you had look at that particular issue separately.

Alternative flood control measure cost, this is very often ignored in the economics. Sometimes there are more economic ways of dealing with flood control then using a dam. But that can become a controversial issue. When you're looking at nonmarket values you have to be very careful how you develop those nonmarket values.

My favorite bad study is the one that was recently released on the Klamath River, which said that ten percent of Oregon was recreating 12 weeks a year on the Klamath River. So somehow that got through the process. But there are many good studies that have been done on that as well.

And then looking at, and including, your decommissioning cost, dredging, clearing the channel, etcetera. And then you also have to discount your future benefits from the decommission, because often the restoration effects won't occur for many years down the road due to sediment transfer and other issues.

You want to calculate your benefit cost ratio, and then look at the cost of alternative mitigation measures and compare that to what you're doing with the decommissioning.

And with that I'll close, and I'll turn it back to Jim who is going to talk a bit more about this issue.

MR. MCKINNEY: Thanks, Rich. And, Al, if you could really keep me on track because I've got way too much material here, and this is a pretty intriguing subject. The Energy Commission has done assessment for three proposed decommissioning projects in California. These are power dams.

As Ted Frink mentioned earlier, there's a lot of work being done on decommissioning non power dams, but there are four that I'm aware of, three of which we've looked at, Battle Creek, Trinity and the Klamath, and then Inglebright with which the Energy Commission is not involved.

I think a lot of this has been covered already, but when you think about decommissioning, just remembering we've got three runs of salmonoids that are endangered in California. We talked about habit losses. One of the things I didn't present this morning from our 03 environmental performance report is the distribution of hydro projects and the distribution of extent and former salmonoid habitat associating with hydro projects in California.

So the San Joaquin, Sacramento, and North Coast drainages have got a fair amount of hydropower, and also have a fair amount restoration opportunity. There are a number of state and federal laws and policies guiding restoration of salmonoids in California, including the Salmon and Steelhead Restoration Act, the Cal Fed implementing legislation, or authorizing legislation.

Then ESA and CEQA recovery planning. We provide these assessments upon request. We do not go out looking for projects we think would be nifty to get involved with. And we really just focus on energy information. So energy, the effects of energy changes on system reliability, we also have the capacity to look at cost issues.

But we take a much narrower view than Dr. McCann has pointed out. And his is the proper way to do it. And that's not our job. It's the job of the lead agency or the lead suite of agencies, whether it's through Cal Fed or FERK relicensing, or what have you, to really figure out what is the ultimate benefit cost ratio for some of these proposals.

So when we think about the energy stuff we're looking at system reliability, energy and capacity changes. We look at this in the context of state and regional control areas and supply demand balances. Replacement power, power cost and emissions, another thing that we know how to look at.

Criteria and thresholds for, quote, unquote, significant effect, significant effect has a legal definition under CEQA, and we want to make sure that that's used appropriately. We generally have not review project or firm level economics associated with these issues.

The first time I talk about Battle Creek I'm going to do this in a little bit of detail, and then I'll pick up the pace and kind of go a little more cursory overview for the Trinity and the Klamath. Battle Creek is a five power house project owned and operated by PG&E. It's got 36 megawatts. It's a run of river project.

So there is no storage. There is no dispatch ability associated with that. Average annual production is about 245,000 megawatt hours, or 245 gigawatt hours. This particular creek is located on the, where is that, north east side of the Upper Sacramento Valley. There are still good salmon runs and this is one of the tributaries of the Sacramento.

And it's got habitat for spring run chinook and steelhead on this restoration potential for about 42 mainstream miles above the dams. This project is a joint Cal Fed, PG&E endeavor. And then the State Water Board is lead agency under CEQA in producing the environmental review documents.

The restoration option that we were asked to review by the Water Board was this one, removing six dams, the loss of 7.2 megawatts dependable capacity, 93,000 megawatt hours. The administrative draft, DIR, calculated about 5.1 cents per kilowatt hour for replacement cost. That's both energy and capacity.

With the total net cost to rate payers of about three million dollars. These were our findings and comments back to the Water Board on that particular draft. From a capacity and energy perspective, these are non significant numbers when you think about regional or state level system reliability.

No significant environmental effects from thermal replacement. This can be an issue of concern if you lose some hydropower. The thinking goes you have to make up with that, make that up with thermal generation, whether through natural gas or coal. And you have an increase emissions SOCS, CO2, SOCS, etcetera.

We found a replacement cost to be reasonable, although at that time it was not clear where the capacity cost came from because there didn't appear to be a reliability contract. We did not think that the three million dollar annual cost figure would be significant.

Why did we think all these things? Some of these numbers I've thrown out before and other people have spoke to them. Again, we've got about 53,000 megawatts of capacity here in California spread across natural gas, nuclear, hydro and renewables. About 14,000 of that is hydro. And I meant to get the D rate number and I got XX.

So Jim, or Karen or Al, if you remember the system D rate for California hydro.

MR. WOODWARD: CAL ISO D rates is about 3,000 or 3,500.

MR. MCKINNEY: So 11,000 dependable then D rate.

MR. WOODWARD: At most.

MR. MCKINNEY: Okay. Thanks. Again, summer peak demands when you build in the reserve margins in California can exceed 60,000 megawatts. That gap between 53 and 60 is made up through imports. And that does include the reserve margins. And, again, on this particular project there were no appreciable peaking reserve resources to talk about.

Energy numbers, I've discussed those before. Again, the annual variance in hydro production in California is big. It goes from nine to 30 percent of our state load. Again, summer demand, 700 gigawatt hours, replacement power. For the emissions stuff, we thought that was interesting to look at.

So 93 gigawatt hours of thermal power generate about 9,800 metric tons carbon. That would be a .03 percent of the state total. And as a point of reference, the thermal power plants in California generate about 2.2 percent of the total emissions. For the next one I'm going to talk about -- how am I doing on time?

MR. ALVARADO: About three minutes to make it ten.

MR. MCKINNEY: Okay. Okay. Here we go. Trinity, this has been a somewhat controversial proposal. This was built as part of the Central Valley Project in '56. And it ended up diverting about 75 percent, 74 percent, of the Trinity to the Upper Sacramento River watershed, and down into the Central Valley.

This particular project reduced populations of chinook by 67 percent, and steelhead by a little more than half. This was a long-term multi agency, multi stake holder planning effort that went into all this. We just came in a little bit at the very end. The goal is specified in the 2000 record of decision, was to increase the flows to about half of the historic average.

Shortly thereafter a suit was filed by energy and water contractors who were using CPP power and water. And a federal judge directed the lead agencies to prepare a supplemental EIS/EIR looking specifically at the energy issues. So the comments we provided were within that legal framework, scoping comments on the recirculated

EIS/EIR.

Just a little bigger project, four power houses, about 500 megawatt capacity. It produced about 5,000 gigawatt hours. It's getting to be a more interesting number at the state level. 28 percent of that power is used by the bureau. The rest of that power is provided what are called power preference customers at very, very low prices, long term contracts.

Those are nice contracts to have. And the Municipal Utilities have contracts for about 1,000 megawatts. Findings in the document that we reviewed, it would be a seven megawatt loss in dependable capacity. And then 287 loss in energy, 287 gigawatt hours. If you put a dollar figure to that it would be five and a half million.

That's a three percent reduction total project revenues. Replacement power is available at a higher cost, $1.25 megawatt increase. And let's see, that's a very modest number. In one of the things that caught our attention is that in this particular lawsuit was reference was made to the effect that loss of this project energy and capacity might have on the state in its efforts to maintain system reliability.

This is an overview of the things that we looked at. And one of these is -- again, we look at things in a regional and state context for reliability. We thought it was a generally good analysis. We had some questions about their characterization of the power crisis, which we provided in comment.

One of the things that we recommended to you was, you know, when you're talking about the scope of your impact area, be specific. Are these the power preference customers? Is this Northern California? Is this a particular control area where there are generation constraints or transmission constraints? Or is this at the state level?

We also go into somewhat confusing use cost as a proxy for energy losses because those numbers can vary. Let me go briefly to what we did on Klamath. This is a project up in the northern part of the state that's undergoing relicensing. The Klamath basin, support of the third largest salmon runs on the west coast of US after (indiscernible) and Sacramento systems.

The lower dams in that due block passage to upper reaches of the river, and a 50-year license is up for renewal now. We were asked by both Resources Agency and the State Water Board to look at the energy issues associated with possible decommissioning of this project.

These are some of the questions we raised internally. Is this a feasible NEPA alternative from an energy prospective? What is the Klamath project? What's the supply demand balance of pacific or service territory and control areas? Would this effect electricity resource planning? And how does energy fit in benefit and uses for the Klamath?

Seven dam project, these are the generation numbers, 163 megawatts capacity. 656 gigawatt hours per year. Some of the projects are in Oregon. The rest is in California. And this particular project covers 64 miles of the upper stem of this river.

This was a little tougher for us because we had to go look at Northwest Power Planning Council. And it was quite balances in the north west as opposed to California because Pacific Corp primarily serves the north west. I'm just going to scroll through these quickly. This is available on a handout out on the tables. You can look at it at your leisure.

One of the things we noted, there's a lot of new generation going in in a particular area, Northern California and Southern Oregon. These are the energy losses from the proposal. Again, these are very modest numbers when you're thinking of it in terms of system reliability, supply demand balances, etcetera.

Our conclusions, decommissioning one or of the dams is a feasible alternative in the prospective impacts to electricity resource adequacy. Replacement energy is generally available, although it would be at higher cost. The northwest and California are going to need new generation, transmission and conservation to meet reserve margins in the future.

Changes in energy capacity and production at this scale, again, so 76 to 163 megawatts is just not -- that's not going to effect those long-term planning goals one way or another. We do recommend that more project specific studies be done for this by a qualified contractor.

We also note that energy is really just one of the issues up there. There's some really serious water quality problems, water allocation issues. And fortunately we don't have to make decisions on any of those. So there's a few lessons learned. Selective decommissioning to help restore fisheries as a viable method.

It's not a panacea. There's a lot of issues associated with it. But it is a tool in our toolbox for restoration and mitigation work here in California. Low energy, high environmental impact projects are good candidates, as we've demonstrated with review of the numbers.

A key policy question, and this is the tricky one, how do you balance private losses with the public benefit gains? I think the public benefit values from this type of work are self-evident. Where it gets really tricky is who is going to pay? Which stake holders are going to bear the brunt of that? And that's a tough question.

Just in closing, pay attention to questions of scale. What might look like a big percentage decrease for an individual operator, service provider, utility, may be fairly small at a control area level or at a state level. Pay attention as the run of rivers at storage, very,

very different creatures, very different values to the state as a whole for meeting reliability goals.

It's also important to remember, too, that, you know, electricity is not a zero sum gain. We have an increasingly integrated western market. We are going that way. Nutrients missions is being developed. This is really an integrated system. And if you get a little decrease or an increase in power at one part of the state, one part of the western grid, there are lots of resources available to make that up.

Cost might be different, terms might be different, but the energy is out there. So don't think about it in terms of zero sum, you know, ten megawatts here, got to find ten megawatts someplace else. It doesn't quite work that way.

As I alluded earlier, one to one correlations between losses and hydropower increases and thermal production really aren't quite accurate, again, because of the integrated nature of our western resource mix, and some other reasons.

And lastly, there's something that we call the hydro swing, which goes to the notion that, you know, hydro was kind of the foundation for power generation in California. But we always knew that it was a variable resource, and especially in the post-war period. The thermal system that was developed by the big IOUs had to account for those differences in hydro production on an annual level.

The system basically works, didn't work in the power crisis. But that was a different set of factors. But the system was built around that. There's a lot of redundancies to account for those variations in hydro production.

But as Karen Griffin, our EPR manager, alluded to earlier, there's a lot that we don't understand yet about the hydro swing and what that means in our ability to meet reliability requirements and goals in California. That's that one.

MR. ALVARADO: Thank you, Jim. Thank you, Richard and John. Jim, have you had a mind to allow an opportunity for questions and answers at this point?

MR. MCKINNEY: I think this would be a great time to have some discussion and questions.

MR. ALVARADO: If anyone wants to ask

any questions please come on up to the microphone.

MR. WOODWARD: Jim Woodward, California Energy Commissioner. I have a question for John and Richard. The California market a couple of months ago had an announcement that they were doing new hydro newsletter. And two of the big bears about relicensing was that there would be too much money left on the table for those that were looking at mitigation and other conditions.

And the owner were afraid perhaps that they'd be squeezed too much for some of the revenues versus cost projections. How might your work and other policies be employed to drive fear out of that negotiation process and drive more transparency into the data, into the negotiations?

It seems like we're not prudent by having to sort through a great deal of transparent data on operating costs.

MR. MCCANN: Yeah. Maybe I'll do the general and then John will introduce the specifics through El Dorado. I think that a lot of the questions that are related there are trying to understand for specific projects what are the true cost of those projects? Including one thing that we have not gotten to yet, which is the capital cost, both in terms of existing capital investment and what future capital investment will require.

And then more fully understanding what are the true cost associated with the relicensing process? And that second question actually has to be answered more clearly with detailed system modeling of the particular hydro systems that you're looking at. And I don't think that's been done to date.

Most of the estimates that I can tell from looking at the FERK is almost back of the envelope analysis, rather than looking at what -- looking at something akin to what they did at El Dorado, which was take a 25 year water history, run it through the system, simulate it and look at the changes.

And I think when you do that then you get a clearer picture of how many dollars really are on the table. Maybe I can have John talk a little bit more specifically about how they did that at El Dorado.

MR. KESSLER: Well, the other gap we have to bridge is some of this information is considered priority. The owners can effect their ability to compete with others. And so I'm not sure how to bridge that gap. I know that's a perspective of the utilities and other owners out there.

But to the degree that that information can be forthcoming, it provides kind of a common understanding of all the parties, the agencies, as to who are we really working with here. From a standpoint of a project owner, they don't necessarily like to show their cards and reveal what their margin is. Just how much of a margin is there to play with here?

So I don't know that the current framework provides that clearly. FERK certainly does their own assessment as part of their environmental assessment, EIS process, to kind of bring that together. But as to knowing that during the licensing process, and having that as another tool to work with, I'm not sure that the opportunities are really there yet.

MR. LIVINGSTON: Randy Livingston with PG&E. I guess, Richard, I'm wondering with the utilities back in the procurement business with almost of all California's hydro in the hands of utilities and municipalities, irrigation, water districts, the state and the fed, you know, some time ago we were looking at the model that you had up there, which was, you know, here's what the market is doing and how do you optimize against that.

Today, I think most of us are looking at how do we deliver the electricity to customers, at least cost. I'm wondering, there's a bit of a conundrum where in relicensing you look at what does it take to make sure you get the restoration necessary for stream.

But today we're looking more at what is the cost to serve? And I'm wondering is the revenue model really fit, as we look at that anymore, or what is the changing cost as those benefits flow to the customers today?

MR. MCCANN: Well, actually you alluded to this earlier that in the dispatch is a hydro system that the criteria prior to '98 that PG&E and the other utilities use was generally an economic optimization approach essentially trying to get hydropower into the highest value hours in terms of generation.

And in fact, in a competitive market, which is one of the assumptions that we use, big if, but if you're doing your modeling, and you're looking at these models, the way the models are set basically is to look at a competitive model.

In fact, as a side, many of these models have had problems dealing with market power issues. But in that situation the least cost dispatch is actually equivalent to the maximized profit situation for a competitive firm. They are equivalent.

And so when you're looking at -- that's why I brought up the issue that the opportunity value of the hydropower is the same as is the flip side of the revenues that you would be getting from that hydropower if you were a generator selling into the market.

The opportunity value and the revenue should be equivalent in the market. So what you can do is use these price values, use the marginal values, an indicator of when you should be trying to run your hydropower plant at its maximum output. On the day when the price is at the price cap that's the day you want to have your hydropower plant running full blast.

At night, in the middle of April when the price is starting to approach zero, that's the time you want to shut down your hydropower plant.

And so that is really that criteria -- the criteria really doesn't change in that way. And so also that opportunity value represents a value to the customers.

That is that the customers have that same view, that the way for them to minimize the revenue, their cost, is to use the least cost dispatch approach. And so from a cost of service prospective, basically PG&E and Edison and the other utilities that are doing hydro optimization, should be using the same out rhythms and approaches that they would if they were doing the same thing under a price driven system in which they were basically generators.

And I think that that would probably be the final outcome. And so that you've got that. Of course you have these tradeoffs again in relicensing. One of the things that happens now that you have cost of service basis is that you now have the entities that will be benefitting from the environment values as being essentially the same people who will be losing from the increase generation cost.

It's like the argument that rate payers and taxpayers are essentially the same population.

And so people, that general population, that is recreators and enjoy environmental outcomes, are also rate payers. So they're basically taking out of one pocket and putting it into another pocket.

It's not as though the hydropower plant is -- you're taking profits from a set of entities that are in Texas. You're really taking -- you're passing money from one side to the other. And cost of service also means that the utilities can turn around and recover the cost of relicensing with much more assurance than they could under a deregulated regime.

So I think that in some ways you might argue that going back to a regulated environment actually allows that you can impose more stringent relicensing conditions in that kind of situation.

MR. MOLLER: David Moller, Pacific Gas and Electric. I actually had a question for you, Jim. When you put those numbers up about the study, the Aspen, I thought those were very interesting numbers from the I think it was 11 projects that were looked at. And I had a specific question on that.

You gave a number somewhere around 5.3 percent as the cumulative decrease in average annual generation for those. This is just a very specific question. I was curious whether that netted out the increase in generation from the capacity increases, or whether that was the gross?

MR. MCCANN: I actually do not know the answer to that. And we can get back and provide that when we do the final report, and make sure that's in there.

MR. MOLLER: Great. That would be good. And then, Richard, just one really quick comment on the conversation here. The issue of coming in at margin however it's established, is maybe a useful tool in many cases. But I think it's important to focus on what we're talking about here in terms of conditioning hydro licenses as achieving certain societal objectives, especially around environmental protection is what we've been talking about a lot today.

And the basis for that should be coming in from what's needed to achieve the environmental protection, not on the basis of how much margin may be able to spend to achieve that. And I think John's example of El Dorado is a perfect example of that. Did the fact that it would result in a project that was not an economically viable project, just as a power generation project, stop that license from being so conditioned?

Conversely, because there's a margin there, should it be spent specifically for that purpose? Or should society get the other benefits, a lower cost power generation? So noting that --

MR. MCCANN: No, I absolutely agree.

MR. MOLLER: Yeah. So I just --

MR. MCCANN: You to value. That's why in my decommissioning list (indiscernible) nonmarket evaluation. I think that that's an important criteria where you need to determine, you know, that we convert these values into dollars. But really what we're talking about is resource tradeoff.

So we need to call it out googles or, you know, something like that. We're trading off one set of googles for another set of googles, and make that clear about the tradeoffs, and not say, you know, on the environmental site, you've got an unlimited budget, you know, up to the revenue margin that's available here. We absolutely can't do that.

MR. MOLLER: Sure.

MR. MCCANN: Yeah.

MR. MOLLER: I just wanted to make sure that point got out there.

MR. MCCANN: Yeah.

MR. MOLLER: Thank you.

MR. MCKINNEY: We're going to take one more question and then we'll need to keep moving here. Ms. Taheri.

MS. TAHERI: Pam Taheri from SMUD. Jim, I have a question for you. I see that when you're doing the financial impacts, and then you look on that and say, gee, the conclusion is that this is very small megawatts, and very little energy in terms of it being from a western system wide, no big deal.

But is anybody looking at it from a cumulative impact standpoint in terms of, you know, ten percent loss here, you know, 15 percent there? Pretty soon it's real megawatt hours and megawatts?

MR. MCKINNEY: That's a good point. And that's one of the reasons that we wanted to do this. This is a baby study. This is a simple little exercise here. But that's the first time we've been able to find -- I mean we were not able to find the type of information you're suggesting that we do, which is look at the cumulative losses in hydro generation, both capacity and production over a certain time period.

So this was just an initial effort to do that.

MS. TAHERI: And I hope you don't mind, I have one more comment, which is that I totally agree with what Dave just said from PG&E in terms of it. My understanding is also from looking at environmental in terms of looking at a societal value as exactly that, which is let's take a look at it from a technical standpoint, biological or otherwise, to see how we can support it, not necessarily from an economic standpoint. Thank you.

MR. MCKINNEY: We'll take one more.

MS. MANJI: Annie Manji with Department of Fish and Game. And this question is for either Mr. McCann or Mr. Kessler. When you were doing your evaluation of the various cost associated with relicensing, either in the specific case of El Dorado, or more general cases, did you find any correlation with the amount of money that was spent during the relicensing, and then the amount of money that had to be spent on adaptive management?

Like if a licensee spent a lot of money doing studies, data collection, did they end up with a more economically justifiable license conditions, or did you see any kind of relationship like that?

MR. MCCANN: Actually, we haven't, for example, we haven't compiled the application cost study for Rock Creek or Mokelumne, which were the only two licenses that were completed that we had information on. And the other licenses hadn't yet been approved. So we didn't have the mitigation cost for those yet. So, no, we haven't done that aspect.

John may have a little bit more about El Dorado specifically, but that's the only case that we have.

MR. KESSLER: I think in general, Ann, there tends to be a relationship that the more complicated project the more difficult it is to understand the environmental benefits and culture values versus the actual generation benefits. And the more it takes to invest to study that, and to go through a process and agree to terms, probably the more complicated those adaptive management measures are, and the cost to implement over time.

MS. MANJI: So it might actually be a positive correlation, the more you spend on your studies the more you spend your license?

MR. KESSLER: I think that's general. There may be some other opinions here. I mean PG&E has certainly some really good first hand experience. Dave Moller and other project managers might be able to offer, but really I don't know that's really such a return on investment for, you know, the application process.

And then seeing a real benefit of necessarily at reduce cost and savings, and implementation down the road. I haven't seen that personally.

MS. MANJI: One thing in the future as you go forward with this, something else I would be interested in looking at as more licenses comes to fruition, the amount of time spent in relicensing versus the amount of money spent in adaptive management practices as part of the license.

I know Mokelumne, that was a record setter, correct, in terms of time of licensing.

And then El Dorado, it sounds like it was really a fairly quick process. And sometimes I'm wondering are we spending our time wisely I guess. Time would be a factor to look at, not just dollar cost. Thank you.

MR. KESSLER: And I think we are dialing in the process to one that's more generally acceptable to the parties and the Resource Agency so that we can produce that process time and get to the point of relicensing agreement.

MR. MCKINNEY: We had one more gentleman in the white shirt.

MR. THEISS: My name is Eric Theiss. I'm a biologist working for the National Marine Fishery Service. And I'm involved with hydro relicensing here in California. I just had a question for you on the societal value of anadromous fish and whether you've been able to calculate that into your projections.

We're responsible for spring chinook, steelhead, winter run, which are endangered, a number of different anadromous species that all fall within the Federal Power Act. And I'm wondering are we intending to, you know, look at power production as trying to find the minimum possible cost for society?

So the cheapest utility bill, or are there other values that we should add into a projection like this that we should compare against just power?

MR. MCKINNEY: Are you going to take that?

MR. MCCANN: I guess I can. I would start off by saying that as a resource economist, when I say minimize cost, I actually include everything, including what some people say societal values, so that you would be dealing with losses of a ambiguous fish, etcetera, as those types of cost. And you're actually for these projects you're trying to minimize total societal cost.

One thing is that there are also different nonmarket values that you're dealing with. For example, I want to make a distinction between whitewater recreation and ambiguous fish in that when you're dealing with whitewater recreation, to be honest, I think that that kind of valuation can be traded off directly with turning on your dishwasher. That they are both human consumption issues.

And that humans are making choices about what they want to do, run their dishwasher or whitewater raft. Those values can be compared very directly. If you can put up a gate at the river and charge an admission fee you could find out how much whitewater recreation is worth.

Ambiguous fish is a more complicated issue because in many cases you're driving the species to extinction. And so that you have what's in economics called safety first issues where you've got a constraint that you say, okay, this has to be at this level in order to maintain that fish run.

And that there's a basic value in maintaining a fish value. And so you incorporate that as a constraint rather than directly as a value in your analysis. And then so you're minimizing your cost against the maintenance of this particular fish run. And so that's one way of dealing with it.

In terms of other valuation, I actually -- I know NIPS has done a number of valuation studies, at least in the north west and elsewhere. I don't remember any specific ones down here. I'm sure you're familiar with them, whatever ones there are out there. But I do know that the ones I've seen have been fairly well done by NOPS. That's about my answer.

MR. THEISS: Thank you.

MR. MCKINNEY: And if I could add a little bit to that. You know, there's some great methodologies out there for contingent valuation, and you're looking at, you know, existence values, bequest values, you know, natural resource damage assessment, gets at some of this stuff.

One of the things that I thought would be interesting from a ESA perspective is what are the direct cost for all the people that have to comply with, you know, any say species, or if you got spring run chinook or coho, you know, what are the direct cost to all the people that are applying for permits or have existing programs, you know?

What are they expending to comply with that ESA requirement. If you D list that species and make those direct cost go away, what kind of economic benefit have you created? I think that's maybe an easier way to go then using some of the contingent valuation approaches for this particular species.

MR. ALVARADO: Okay. I'm going to --

MR. MCKINNEY: Waiting for your next panel. Let's go to the next panel. Again, thanks very much. Let's see, I'd like to get our next group of speakers organized and up here. These are primarily Energy Commission staff with their PIER program

And we will have Joe O'Hagan, Michael Kane and Pierre du Vair. And they're going to talk about some of the public interest. And Guido Franco. Excuse me. And they're going to talk about some of the research programs that are being done under PIER here at the Energy Commission.

And just as a time keeping matter we had 30, 35 minutes allocated for this series of speakers. So, again, if you can go on the shorter side rather than the longer side, I know the afternoon close of the day panelists would really, really appreciate that.

Let me find Joe's bio here. Our first speaker is Mr. Joe O'Hagan. He's been involved with the water and energy issues here at the Commission for 15 years. The past four years he's been involved with developing research, addressing the effects of electricity generation, transmission and use on water resources through the Public Interest Research Program.

MR. O'HAGAN: Thank you, Jim. As Jim indicated, I've been here at the Energy Commission for a while and I'm working on the Public Interest Energy Research Program. And for those of you who are not familiar with this program I'd like to give a real brief overview of it.

In 1996 when the electricity industry here in the state was deregulated, the legislature authorized the Energy Commission to conduct the research and development program. The slide here, the second bullet, has the PIER program emission statement. But what's important here, I want to point out, is that we were to address research and development that would not be addressed by a competitive or regulated market.

But what's not indicated up here is that even though the title refers to energy, what we're really talking about is electricity. Here at the Energy Commission, the PIER Program has six different sections, two dealing with efficiency, two generally dealing with generation technology, one cross cutting area. And then one environmental area that I'm in.

The next speaker, Mike Kane, is in the renewable energy technology area. And Guido Franco, who will also be speaking shortly, is in the environmental area with me. The environmental area has expertise on indoor and outdoor air quality, aquatic biology, land use, water quality and water supply, as well as global climate change.

This slide has a vision of the environmental are in the PIER Program. And the thrust of it is that we're trying to address information needs and provide solutions to the environmental effects associated with electricity, generation, transmission, and use.

And this information, hopefully, will go towards sounds policy making, as well as decision making in such situations as FERK relicensing or citing cases. Several years ago the PIER environmental area completed a strategic plan that identified high priority issues for the area to address.

One of those was the effect on aquatic species and habitats through electricity generation here in California. And of course the key component to that is hydropower and its effects on the state's fresh water ecosystems.

Coming out of that, we started a program that I've been heading up to address this issue, try to identify what the information needs are to provide services both to agencies, the utilities, and other stake holders to may informed decisions on the best way to handle our resources.

The thrust of this effort is to identify research that will help us in terms of reducing the cost of mitigation, and enhancing mitigation measures, shortening permitting process, and other intangibles associated with this area. Coming out of this, we've been conducting planning efforts that mostly focused on three road maps, or strategic plans.

The purpose of these is to identify key issues involved with hydropower effects and aquatic resources, identify the existing information base, if you will, current research, identify what the research gaps are, identify the priorities for those research gaps to be addressed.

Coming out of this effort, in the process of preparing three road maps, one dealing with fish passage, one dealing with water quality, and one dealing with in stream flow determinations. These are all issues that effect all or a portion of the hydropower system in the state here.

As you heard us earlier, certainly in stream flow is an issue on almost every FERK relicensing project. It's also a major issue on water rights determinations and other aspects. Later this month I'm going to be holding a workshop where we'll be soliciting input, people's comments, on the three draft road maps.

And the workshop will be held across the street in the Bonderson Building. And the draft road maps will be available on the Energy Commission's website. Talking about current projects, earlier today you heard Jim Canaday talk about the ramp flow issue. They had approached our program from the State Water Resources Control Board about doing a project.

Coming out of that, we recognize that there is a major concern over this issue either to load following discharge, associated with hydro operation, (indiscernible) management discharges or, as indicated by the slide, recreational whitewater rafting discharges that we're seeing more and more of the FERK relicensing projects.

To address this issue we had close to a million dollar contract with the Center for Aquatic Biology at University of California Davis. They're developing a team of experts to identify and prepare a white paper that would identify high research priorities. Following which then the University of California will prepare out request for proposals for submittal for contracts for funding to address these high priority issues.

So right now, the technical advisory committee is being prepared and we'll be planning a public meeting to discuss this shortly. So if anybody is interested, please contact me about this. Some of the issues associated with this that we've looked at so far are dealing with like stranding of salmon fry migrating downstream on the lower Mokelumne because the ramping flows washing away of potentially endangered species and amphibian specie, egg masses, and then also disrupting the macro and burbet communities that serve as a basis for the whole fresh water ecosystem.

Okay. Another current project that we have going on is the integrated forecasting reservoir management demonstration project. This is a project we're collaborating with NOA and CAL FED to show improved runoff forecasting and reservoir management projects at four Northern California Reservoirs, Trinity, Shasta, Folsom and Oroville.

The purpose of this is to enhance the way we identify potential runoff that a reservoir manager would have to deal with. These reservoirs of course are all multipurpose reservoirs, so they're always faced with the dilemma of spilling water to ensure flood safety, retaining water for water supply, retaining water for hydro production, and also meeting environmental requirements.

Given that the future climate may be drastically different than our historic last century say, this project will use global climate change models to identify potential scenarios. This information would be downscaled to the appropriate watershed level.

And then we would develop what they call ensemble forecasting, which is a probability forecasting approach to allow the reservoir manager a greater if you will in a likely runoff situations. Also, they're developing decision support system for the reservoir manager to make allocations of the water resource among the competing demands.

PRESIDING MEMBER BOYD: Could I interrupt you with a question. Could this lead to a change in the traditional approach to determining flood reservations for reservoirs?

MR. O'HAGAN: I don't believe in terms of flood reservations, no. That project is just getting started now. They started utilizing the global climate, regional global climate models, and they're starting to try to downscale this information to scale applicable to the reservoir watersheds.

But this is a five-year project, so we're very early in the process. One of the projects that I'm working on right now deals with macro and verbis, or bugs as we call them. One of the issues facing hydropower in the state is how do you really tell how the facilities are effecting downstream or upstream, aquatic ecosystem.

Certainly you can monitor water temperature and flow levels, but are those really accurate proxies for a healthy ecosystem. One of the issues I think that came up on the Mokelumne was that to address this issue you were looking at the amount of bio mass on the river per a mile reach say.

What we hope to do is take the standard protocol, which is for a record bio assessment dealing with macro and verbis and see if this information can be correlated to hydropower operational parameters where you can tell that because of some issue dealing with the hydropower the macro verbis community is in good, or fair shape.

Right now you could do that, but it's just a general watershed indicator. We're also looking at the use amphibians or fish of the ecosystem as effected by hydropower generation. To see whether they would be even better proxies for aquatic ecosystem health. Now, the road maps that I mentioned earlier, the plan there is once those road maps are finalized, we'll be preparing a request for proposals to fund research that would address the high priority items.

So if there's any questions. Thank you very much.

MR. MCKINNEY: Okay. Thank you, Joe. Our next speaker is Michael Kane in our technology and renewables division. Mr. Kane has a BS in mechanical engineering from Cal State University Sacramento. He worked for nine years as a maintenance tooling designer at the Sacramento Army Depot, and two years with Cal Trans as a transportation engineer.

For the past 18 months he's been working as a mechanical engineer here at the Commission in the R&D branch of the PIER renewables program. He's currently our technical lead for small hydro research and development. Welcome, Michael.

MR. KANE: Thank you. I'm here to talk a little bit about the PIER R&D efforts. Let's see, it's a little bit out of order here. Okay. Most of you know that PIER stands for public interest energy research. And as you would expect, what we do is we fund research and development into small hydro, or actually generally into renewable technologies.

Let's see, we cover five basic program areas, wind, solar, bio mass and bio gas, small hydro and geothermal. Geothermal is actually not under PIER. It's under GIRTA, but I'm taking credit for it anyway. Of these areas, small hydro is currently the smallest.

There are a number of reasons for that, partly because there's a perception that hydro is a mature technology and it has very little need or R&D, which in the case of performance of large hydro is true. It's pretty well developed. There's not much room for improvement on performance, though there is significant research and development going on to mitigate the effects of large hydro projects.

Another reason for -- the reason it's kind of small is it's perceived that all the good (inaudible) researches are taken. Again, with large hydro it's true, but small hydro there is still significant potential. Most of the potential we've identified is in either underpowered or unpowered dams.

And we see the potential for implementing what we call inframental small hydro, which is powering these dams or adding power to these dams in an environmentally benign way. And another thing we're trying to look at is in need of research and development, is very low head hydro.

We believe there to be a lot of hydro is very low head that's a bit below -- that falls outside the general operating envelopes of your typical hydro equipment. And intend to do some future research into that area. So between very low hydro and incremental small hydro, that kind of scopes what we are -- our small hydro efforts in PIER and NOBLES.

Okay. Well, I don't have my -- the slides didn't copy onto my disk. So I'll have to wing it. So what we've got, the first thing we do is give you an idea of what we have in the way of installed capacity. Currently the installed capacity of small hydro is about 1,350 megawatts, which is not very much, but it compares favorably, resources like wind or even bio mass.

What we've got in potential resources for the most part comes from a study done by the Idaho National Engineering Environmental Laboratory in 1998 called the US Hydropower Resource Assessment for California. It identifies approximately 300 existing dam sites that are even under powered or unpowered with a total capacity of about 2,500 megawatts.

The megawatts identified are not raw

megawatts. It has been weighted according to what they call a project environmental suitability factor. What the factor does is it takes into account fish and other fish, other wildlife considerations, and determines a likelihood that this resource can indeed be developed.

And they kind of range anywhere from .1, which means no change, to .9 where those are kind of the ones that you have a reasonable chance of doing some development. The second document I work with is DWR bulletin 211 from the Department of Water Resources. It's a very old document done back in '81. And some of it's obsolete.

Some of the sites that they've identified in it have already been -- I know have been developed. And others are probably no longer feasible. But I use this basically to determine the nonempowerment resources because the O'Neil Report isn't very good in that respect.

Okay. Two studies together -- okay, excuse me, the O'Neil report identifies about 550 megawatts of development resource. But, again, like I said, it's hard to say exactly how good that is because it is so old. It does overlap with O'Neil. To what extent, it's very difficult to say.

And the methodology is involved in these two reports are very different. So comparing the numbers really makes no sense at all. One potential resource of course is not addressed by either report is the very low head hydro opportunity. We believe there to be in canals, pipelines and the like a lot of opportunity in very low head.

The amount I've seen as high as 2,000 megawatts, but I haven't seen a basis for it. So I really can't say there's that much available. But one of the things we plan on doing is a resource assessment to determine that. Okay. I think right now what I'll do is I'll kind of discuss project.

I had a pretty good picture of it here but, like I said, it didn't load. So we have really only one current project going on in small hydro, and that is the power wheel project. It is essentially a modern version of the old fashioned waterwheel. Generally, longer, you know, the diameter is about, what, seven feet and about 14 feet long.

So it's kind of got a large aspect

ratio. And it's supported on drum rollers, and suspended in a canal. It's basically designed to be off the shelf equipment so that you -- and to be installed with really minimal silver works. That's cutting down on cost significantly.

And it's also designed to be somewhat flexible so it can be used as either an overshot water wheel with the water coming in on top, or an undershot where the water is fed through the bottom. And the configuration it's used in being determined by what would give you the best either performance or energy production.

Okay. Okay. Well, I guess I was somewhat reluctant to bring up power wheel because it has experienced some mechanical problems. But I ultimately decided to do it because this is R&D and the nature of R&D is more things don't work than do.

So, yeah, basically it was installed near Lost Hills about August of last year, and almost immediately we found it has suffered from vibration problem very close to its operating speed, you know, proving Murphy's Law is still in effect I guess. So anyway, it was -- but they went ahead and kind of altered the -- tuned it to operate at somewhat different speed to lower the vibration and proceeded to test it.

Well, what happened, as soon as they start testing a bearing fails. And so it had to be pulled out, repaired, put back into place. And this time it was put back in a place in an undershot mode rather than an overshot, because that was the area where the contractor felt they could actually get the most energy production out of it.

Well, no sooner than they put it in place it froze up again. This time it's unclear the reason because it has not been removed from the canal at this point. So to sum it up, the status of the project is it's pretty much done. I'm in the process of getting them to close it, close it down.

And the funny thing about it going in I was pretty much a skeptic of it. I didn't think, well, what good -- can we really do anything with a water wheel. And, you know, I didn't really think it was a very good idea. But, you know, now, even though despite all these failures, I don't think this particular effort is the one, but I do see the merits of a water wheel, or something similar to take advantage of these very low head opportunities.

Well, I guess that takes us to basically what we planned for the future. As I stated one thing, we want to do a resource study that concentrates on low head, low impact resources. So that will essentially be developed structures, either canals, pipelines, flows, tunnels, that have developable resource.

The reason we want to go that way is to develop hydro in the current atmosphere is very difficult. There is a lot of resistance and we want to demonstrate in places where there's going to be minimal resistance, and perhaps try to show where we can both make a difference. And that we can, in fact, generate power without any -- with at least minimum environmental impacts.

The second thing we want to do is, after we identify the small resource, and indeed there are five, there is enough there to justify proceeding further, we would like to, again, just demonstrate some sort of low head hydro seam in California either at a canal or even at one of the dams where its deemed suitable.

And as provided in one of the things

with the dams is they tend to have more -- we're
more able to use more conventional technologies.
But to do it there we would have to find at least
some R&B angle to it for us to be able to do that.
And that's what I have. I'm sorry I didn't have
my slides.

PRESIDING MEMBER BOYD: Michael, don't
run away. Jim, I want to ask a question, and
you're next.

MR. KANE: Okay.

PRESIDING MEMBER BOYD: Michael, you've
come as close as anybody today to addressing a
question I've had all day and not known where to
put it on the table. I'll put it here, and maybe
it's not appropriate for you. But I've just been
wondering is there a resource assessment of the
potential for additional, you know, hydro power
from, you know, California Water and Power from
California water systems not presently used for
power development?

And you came as close to anybody to
indicating that at least somebody's thinking about
that question.

MR. KANE: Yes. Actually, we feel we
got a fairly good handle on that with the report

put out by O'Neil. That would be the US Hydropower Resource assessment for the State of California. Because it does identify dams and the like with and without power that have potential for more capacity.

And it actually weights them according to the environmental desirability of doing that site with a .1 being don't both, a .9 being, you know, there's a reasonably good chance you would be able to do something here. It really comes down to a matter of cost. And from our perspective, again, R&D potential.

If there's no R&D potential, you know, our particularly you can't really touch it. But there probably is R&D potential. I just haven't seen it yet or it hasn't been explained to me. Or it could just be some slight changes in equipment, or things you have to do to equipment to adapt it to a particular type of site.

PRESIDING MEMBER BOYD: Okay. Well, I guess since the integrated energy policy report is just that it had to do with policy, a question I'll leave with Al and Jim, and Karen if she's still here, etcetera. I would think we need to address this potential in this report, at least to lay out the possibility that's being developed, what the magnitude of that might be, and the fact that research is being done. Thanks, Mike.

MR. KANE: Okay. Thank you.

MR. MCKINNEY: And, Commissioner Boyd, I think you might recall that during the power crisis there were a number of, you know, incremental hydro technology presentations that we got in different branches of state government. But I think there are a number of factors in economics and regulatory barriers to market entry, and just general feasibility.

For whatever reason, the promise of this technology for these applications isn't really coming through.

PRESIDING MEMBER BOYD: Yeah. I remember that well, as you should too. And it's to me still a policy question that needs to be put out on the table if we're addressing those kind of things.

MR. MCKINNEY: Okay. To close out our PIER presentation I'd like to introduce Dr. Franco, and then Dr. du Vair, who are pretty much our two main people here within the Energy Commission on global climate change.

Guido Franco leads the research activities on climate change for the environmental subject area of the PIER program. He's been a member of the technical committee organized by US EPA to develop guidelines on how to estimate greenhouse gas emissions.

Currently, he's assisting US EPA in the selection of research projects on climate change. He's a lead author for the PIER climate change research plan. And Guido has extensive experience in air quality and climate change issues. He holds a Masters in science from the University of California and Berkeley, and is registered as professional engineer in California. Guido.

MR. FRANCO: Thank you. Good afternoon. Good afternoon, Commissioners. What I would do today is to present a very, very brief presentation regarding our climate change with highlights on past projects, ongoing projects of planned relevance this workshop.

I will start with indicating the vision of our such program is to improve our understanding of the potential consequences of climate change on California. Our role is to inform policy by producing policy relevant research products.

The outline of my presentation is as follows: First, I will briefly mention some of the results of recently finished research projects. Then I will talk about our climate change research and how we are implementing this plan. And then I will finalize with a brief overview of projects relevant to the discussion of this workshop.

We recently finished a research project that provides a very preliminary evaluation of the potential impacts on climate change on California, such changes in vegetation patterns, also potential changes in energy expenditures due to the expected increase in surface level temperatures and changes in precipitation levels.

One of the analysis that I want to talk about today is the analysis about water resources. These analysis was done by Professor Jay Lund from UC Davis. You've seen his CALVIN Model.

The CALVIN Model covers 92 percent of California's population and 88 percent of its irrigated areas. The model was significantly enhanced for this work. The researchers used two climate change scenarios for representing two extremes of what could be expected in the future.

One of them, the PCM or dry scenario is based from the output from the CALVIN Model supported by N Cart, National Center for (indiscernible) Research. The PCM scenario assumes that it will be a small decrease in precipitation levels in the 100 years. The (indiscernible) was based on the results of the Hadley Model.

This is an extremely wet scenario that assumes a very significant increase in precipitation levels in California. The Hadley Model was available in the United Kingdom. The CALVIN model suggests that by at the end of the century annual hydropower generation could be reduced by about 30 percent, the red lines, if the PCM or dry scenario materializes.

On the other hand, if a precipitation level increases in California, hydropower production will be on what we have observed in the past. It will be a significant increase in hydropower production.

However, for the wet scenario, the probability of flooding for certain areas goes from observed levels to three or four times the probability of flooding. For the dry scenario, in order to satisfy the (indiscernible) production. But there's a need to (indiscernible) the amount of flows, that is the flows needed to maintain water quality or for ecological preservations.

So this may not be released to (indiscernible), but that's what was needed in order to satisfy the math. In summary, this study with the CALVIN Models suggests the impacts of climate change on water resources may be significant. But in order to better understand the potential implications of a warmer climate, it is necessary to reduce the level of uncertainty with respect to precipitation levels.

During the execution of our initial research projects, it became clear to us that we needed to develop a long-term research plan on climate change. For these reason, we commissioned several roadmaps of research, which were produced by experts in the different subject areas.

Based on that roadmaps, we developed a climate change research plan that is available on our website. And also we are commissioning two additional roadmaps that would be forthcoming. To implement the plan we would have done this to create a climate change research center.

At the present, the center has three branches, Scripps and the Western Regional Climate Center. This is leading the activity or research activities climate (indiscernible) analysis and modeling. Since this is the topic of interest of this workshop I would briefly describe some of the ongoing projects and plan projects in these areas of research.

Ongoing projects, the Scripps is developing a comprehensive meteorological and hydrological system for California. That would contain data from the 1890s to the present. The data base will have more (indiscernible). For example, it can be used to study climatic trends and test regional climate models.

We are working very closely with the California Department of Water Resources in this effort. The Scripps is also Regional Climate Model. That's called the Regional Spectral Model. Comparing modern results with observation. The model is a simulating conditions from 1950 to about the year 2000.

The model would have geographic resolution of ten kilometers. This is the highest level of geographic resolution ever attempted for regional climate change studies. Once the model has been tested Scripps will use the model for climate projections to the end of the century.

We also found in the installation of non-obtrusive remote environment sensors in key areas of the state, for example, Yosemite National Park. The data would be transmitted on a near time basis to Scripps and eventually the data will be included in the climatic database managed Scripps and the Western Regional Climate Center.

Our list of planned projects is extensive. In my last overhead I will just present a very short list of planned projects. But the basic message is that all the projects, taking them as a group, are designed to better understand the potential changes of climate in California.

Ultimately, we hope to have a full set of more robust climates scenarios for California at temporal and geographical resolution for serious impacts and adaptation analysis for the state.

We hope to reduce the level of uncertainty with respect to precipitation levels.

We will continue to work with the CALVIN Model, but will also use other complementary methods to conduct a more comprehensive study of the potential implications of climate change on hydropower production and water resources in general.

It is important that we're working with technical staff from the different state agencies, and in this case, with the California Department of Water Resources. We're also coordinating our research projects with ongoing national and international efforts. Thank you very much for your attention.

MR. MCKINNEY: Our next speaker is Dr. Pierre du Vair. He's manager of the Energy Commission's climate change program. Dr. du Vair became manager of the climate change program here at the Commission in February of 2001. His current responsibilities focus on efforts to provide information about climate change to evaluate potential policies related in house gas emission and adaptation to climate change.

He's also leading work to provide guidance to California's voluntary greenhouse gas registry. The Energy Commission has a lead role in California agencies in providing information on climate change issues and policies to a wide range of audiences throughout the state.

Pierre has got a Ph.D. in environmental policy from the University of California Davis. He also holds a Masters in economics from the same institution. He has a BA in biology and economics from Humboldt State University. And I would also say climate change really cuts across a lot of the subject areas in our integrated energy policy report series.

It's not getting the time it deserves here, but it is being, again spread through a number of workshops and sub-reports in IEPR. Pierre.

MR. DU VAIR: Thank you, Jim. Well, we've got a little bit of climate change I think. Earlier, Mory Roos here from the Department of Water Resources described some of the types of impacts that certainly warming temperatures in California can bring to the hydrology of the Sierras.

Our PIER Program has funded a lot of research about the potential types of impacts that climate change can bring to various sectors within

California's economy. Within California we emit about 1.4 percent of the world's human or anthroprojanic greenhouse gas emissions. We've got about .6 percent of the world's population.

So we emit more than the average person on the planet for greenhouse gasses. And the US picture looks a little better. We emit about six percent, a little over six percent, of US greenhouse gas emissions. We've got about 12 percent of the country's population.

California emissions of greenhouse gasses have been rising relatively slowly. A lot of things in California like our, you know, building codes, our energy efficient programs, we have a relatively low energy intensity for a lot of our industries in California.

So there's number of reasons why California's emissions are low relative to other areas in the country. But throughout the rest of the US, and certainly throughout many countries abroad, greenhouse emissions are arising fairly significantly.

And so one of the questions is is California getting ready for climate change? And many of you are probably pretty familiar with work by the IPCC, the Inter-governmental Panel on Climate Change. They're involved with, and worked through, the United Nations framework convention on climate change.

But some of the industries that are getting most interested in climate change right now is the insurance industries, Swiss RE and Munich RE. And they have to deal with particular damages from extreme weather events. And you can see just in the '90s is that graph there.

Insurance companies have to pay out a lot more for extreme weather events. There are still some difficulty in a lot of uncertainly on how greenhouse gas emissions affect global climate patterns, and in particular how it's going to affect the frequency of extreme weather events in the intensity.

But certainly there's a lot of evidence that extreme event damages are arising faster certainly than we're building, sort of the economic value in (indiscernible). Within California, our greenhouse gas emissions are rising slower than the rest of the US. I think of the '90s this shows the US up about 12 percent.

The lower graph shows that California is up about four percent, not including our imported electricity. Transportation is our biggest source of greenhouse gas emissions. Electricity generation is only about 16 percent. A lot of their other areas of the country, power generation is up around a third I think is about the national average.

So our transportation sector is our area that needs the most work on greenhouse gas emissions. What has California done? We've passed a fair amount of legislation related to climate change, and not a whole lot of this is related to water and climate change.

As far back as 1988 Senator Byron Sher asked the Energy Commission to study the potential impacts of climate change on California. And we prepared an inventory back in '91. Also, Senator Sher created a greenhouse gas registry and asked us to update the inventory and assign the Energy Commission a number of tasks related to climate change.

AB276, which I guess that's back in 2000, but that's coming near a end I believe, a big hearing tomorrow on that. But that relates to the transportation section and California's dependance on petroleum. Cleanup legislation on the registry was passed in '01. (Indiscernible) is a pretty famous bill. It was passed last summer.

It got an awful lot of attention asking carb to control greenhouse gas emissions out of new motor vehicle in the 2009 vehicle class. And then a bill on storing carbon in California forests. We have protocols for that, and our renewable portfolio standard.

We have an informal multi-agency climatene with a host of state agencies that have been meeting for about two years trying to identify what type of things the state agencies are doing to mitigate greenhouse gas emissions. And importantly, what types of things are we doing to prepare to adapt.

The Department of Water Resources has been one of the most active departments in the climatene, along with the Board and the Energy Commission, and a number of these other folks. That team, predictably a few of the people here, Mory Roos and Doug Asuvian, Gary Bardini from DWR have identified a number of things that California can do to better prepare to deal with climate change when it comes to water.

In particular, they want to focus on how we can improve our management planning and capacity. How do we better determine the types of impacts that climate change could bring on water supply and flood control? I think they want to dedicate more resources to evaluating how we can manage our reservoirs.

We heard from Joe O'Hagan here a little bit earlier. The PIER Program is funding some of these types of tools through that informed modeling effort. So there's work being done, but I think the belief is that there's a lot more that needs to be done. How can we adapt our water system operation models to analyze a range of future climates for California, both temperature wise and precipitation wise.

And then get a lot of this information into detailed hydrology and operational studies, in the Central Valley in particular, how climate change might affect the hydrology of the valley. One other big area that was identified was the alternative options for water management, the ways to improve water supply and quality.

There's a lot of concern that climate

change can also effect water quality, both temperatures and in areas. There's just a number of ecological impacts that climate change can bring to California. Water quality certainly being one of them.

How do we build flexibility into the physical systems that we have, and our institutions? That's probably a really important one. And so there's probably a lot of work that can be done to really spend more time in resources planning in that arena. How do we focus on areas that import a lot of water?

And then what are the types of regional economic impacts? And particular with agriculture, what changes in precipitation and temperatures can do? And then focus on more information. There's an awful lot of uncertainty around climate change. And one of the best things we can do is gather more observational data and try and detect, you know, patterns and changes.

So collecting information is pretty expensive, but there's a need to get a lot more information on precipitation and other climatic data, stream flow, snow pack, ocean and delta levels. There's interest in enhanced effort at water quality sampling and creating a network for hydrological changes that might come about from climate change and detecting those, monitoring sea levels and delta water levels.

And really being able to build a very integrated data system that allows researchers in a lot of academic institutions that have direct access to this information, help us better detect what types of changes are happening throughout California. And then upgrade our supply forecasting capabilities with all the new information as it comes in.

The federal government certainly is spending a lot of effort. NASA has a lot of satellite type date that's coming in, enormous amounts of information now being collected that economically was unaffordable, you know, technology wise in the past.

So there's a lot happening on data collection, but California certainly can do a lot more, you know, close to the ground data collection, and partner with the feds to get a lot better information for regional modeling type efforts. And then, you know, focusing on land use, there's a lot of new information coming out that land use change actually are contributing very significantly to surface temperature changes.

Finally, the state is spending a lot of effort now on updating its water plan. Doug Osugi and Rich, last name Rich?

MR. JURIST: Jurist.

MR. DU VAIN: Jurist. They are both here from DWR, and they are working on the update to the State Water Plan, and it will have a section on climate change. Their website is here. And if you've got questions for them they can tell you more about it. They've got a pamphlet out on the table out here about the statewide planning process. That's it.

MR. MCKINNEY: Thanks, Peter. Thank you, Guido. One observation I'd like to make that when I hear the presenters from our PIER program, it really strikes me how much research is being done and the kind of resources are being allocated, understand some of the public policy issues in different subject areas.

And I think back, again, to one of the statements I made earlier, which is there is so much we do not understand at a really basic level about systems level, environmental effects with hydropower operations in California, or the whole economic question. There's not a lot of transparency there. There's a ton of work that can be done, but I think it would really help inform a number of agencies and decision makers.

But that's work that still needs to be done. I would like us to take a three or five minute stretch break, and then go to the last section for the day. And I just want to make sure all the final speakers have their presentations loaded up, and then we're ready to go. So we can move smartly through that.

(Off the record.)

MR. MCKINNEY: Okay. The idea for the last section today is to invite stake holders, who are really experts in hydro relicensing in particular. Because that's where the balancing occurs. Again, that's a FERK's jurisdiction. CEC has no jurisdiction whatsoever in that. We are an information agency.

And that's part of what we're trying to do is bring together experts who are involved with this on a day-to-day basis. We essentially have speakers from the producer community and the environmental community. And our first panel includes David Moller with PG&E, Steve Wald with the California Hydropower Reform Coalition, and Richard Roos-Collins, an attorney with the Natural Heritage Institute.

I'm going to look for the bios. Here we go. I'd first like to introduce David Moller. He's the manager of Hydro Licensing for Pacific Gas and Electric Company. He directs PG&E's hydropower licensing program, which covers 26 FERK licenses, and about 3,900 megawatts of capacity in California.

He has more than 25 years experience in hydropower licensing, development and operation, and is a licensed civil engineer. Mr. Moller was essential to Mokelumne relicensing settlement in 2001 to set the stage for more collaborate approach now being used in many ongoing proceedings in California.

He has contributed numerous articles and presentations relating to hydropower, and has testified at the California State Senate and the PUC on hydropower issues. He is a graduate of the University of California and has lectured both at University of California and at Stanford University. David, go ahead.

MR. MOLLER: Thank you. So this is not my slide. Can I turn this off?

MR. MCKINNEY: Are you going to use any?

MR. MOLLER: No. Commissioners, thank you very much for inviting me to speak today. And, Jim, thanks for the intro. I'm going to buck the trend him. I'm going to leave the lights on and use no slides. It's late in the afternoon. We'll see if it has any effect. Okay. I want to start off by saying that coming late in the day like this there's been a lot of things said far.

So I'm going to try not to repeat the obvious that has already been said. However, there are a couple of points that have been said that I'll try and reinforce to the extent I agree with them. And certainly, one of them is there's really not much question that hydropower projects have the potential to effect the environment.

That's not the question here. People have gone over in-depth what kinds of effects hydropower projects can have. But there are some questions about it, which are pretty much project specific, like what kinds of effects for a specific project? What is the degree of the significance of those effects relative to that project?

And are the effects ones that we can accept because they're in balance with the beneficial uses of the effected resources? So I just want to emphasize that these effects can be positive or negative today as focused, just a lot on the negative. There's been a few positive effects pointed out as well.

But I wanted to emphasize the fact that these really need to be reviewed on a project specific basis. It's simply one size does not fit all when it comes to hydro. Another point that I'd like to make is river systems are extremely complex. Certainly nobody today has said they're simple.

But the point is, understanding the effects of hydropower on the effected resources is an effort that requires a great deal of comprehensive study and evaluation. There's simply no simple quick answers. As has been pointed out today, there are many environmental considerations that must be taken into account.

Many times there are competing environmental considerations. As Jim went through earlier today, there's a whole series of beneficial uses that have been established for these river systems. Sometimes, as he pointed out, those beneficial uses are competing with each other.

There's continually evolving science. Anyone here who is a practitioner in this field can attest that the science available to practitioners today, even compared to two or three years ago, is a stunning difference. Jim, especially, focused on that, the fact that we're just, we, this is the accumulative we, are starting to understand rivering systems and how these effects all fit together.

There's seasonal considerations, what sounds good in one season may not fit well in another season. And quite frankly, going back to the scene, there's no simple quick answers. There's real risk that without comprehensive study, and without a full understanding of what's going on, in an effort to make some adjustment that seems apparent, like a good thing on its surface, may actually cause other impacts.

One of the undesirable impacts, one of the speakers talked about that these river systems have adjusted to the current flow regimes, into the current uses that the systems are being put to. If one was to take one of these river systems and simply put it back to its unprepared condition, it would have all sorts of effects.

It would be not certain what those would be. So the point is there aren't simple answers. These river systems have to be evaluated in-depth, and to make sure that we understand the effects and the consequences of trying to address those effects before doing them.

That sets us up for hydro relicensing. Hydro relicensing is the forum to do that comprehensive analysis. And it's the ideal forum for understanding the effects and making adjustments. Today, several times there's been comments made about past relicensing. And I'd just like to make a comment on that.

Past relicensing is past relicensing. It is what it is. But quite frankly, again, any practitioner in this room can attest in just the last few years, the last three or four years, the whole relicensing field has dramatically changed in several areas. Much better science available, much better understanding of rivering systems.

And full embracement of collaborative

approach to identifying issues and trying to come up with understanding and appropriate resource measures. So what you get with relicensing today is not what you get with relicensing five years ago, ten years ago, 20 years ago.

I'd like to encourage everyone to look forward on that. What you get with relicensing today is you get an approach that requires a broad ecosystem approach. It's not just looking at recreation. It's not just looking at fish. It's not just looking at macro invert beds, or cultural resources. It's looking at everything.

It's a broad ecosystem approach. It considers all beneficial uses. And this, I think, is a substantial contribution that the State Water Board has made to hydro relicensing is this concept of beneficial uses, and bringing them all to the table, and make sure they're all considered.

It involves all stake holders. This isn't one agency or one interest group, or one operator sitting down and trying to make a decision. It brings everybody together so that everybody's interest, and everybody's views and can be considered. And that certainly includes the state agencies and federal agencies represented in this room.

It's guided by numerous statues, all the environmental statues that have been referred to today since the '70s, not just the federal statues, but also the state statutes come into play. It triggers not only NEPA analysis under the National Environmental Policy Act, but also the CEQA analysis, which is the State Water Board uses for its 401 certifying process.

It benefits from the collaborative process, like I've said. And my personal experience has been people working together will always make better decisions than any one participant or a subgroup going off by itself, because they simply can't consider all the viewpoints.

And then finally, as has been pointed out earlier, relicensing is founded and based on giving equal consideration to both the non-power and the power beneficial uses. So the idea is to periodically look at the use of the resource, and to make sure that use for the next license period is reflecting society's priorities at that point in time.

However, doing it right takes a lot of work. Like I said, it's complex. Typically, in our relicensing proceedings we're doing scores of studies, spending millions of dollars per relicensing proceeding, doing multiple study seasons. This is not a quick thing. It takes years to do all the studies.

There's typically thousands of pages of data and study results that have to be reviewed, analyzed, and interpreted. There's many considerations to balance. And I have to tell you right now, there's so much relicensing going on in California, and there's going to be more in the future, is everybody who's actively participating in this is already stretched about as thin as they can be.

So I just want to point out it's a complex process. These are complex issues. There's a lot of good work going on. And I want to focus specifically now on PG&E's relicensing proceedings. Just to give you sense of how this has changed over the last several years, we have -- PG&E has not received any new licenses since '93 until the year 2000.

Since the year 2000, in the last two and a half years, we have received five new licenses. That's after eight years with no new licenses. We have eight ongoing proceedings right now. In this decade, starting between the year 2000 and 2010 we will start four additional proceedings.

That's 17 proceedings will be in some sort of process in an environmental review. That's out of 26 total licenses. Seventeen of them getting comprehensive environmental review in this decade. In addition to that, three other of our licenses have major environmental reviews going on either as a result of license articles or license amendments.

You add those three, that's 20 out of 26 licenses will be in some sort of environmental review process this decade. So just to give you a sense, that's representing about 80 percent of the total conventional hydro capacity of PG&E will be at some phase of comprehensive environmental review. And that's just PG&E.

As you've heard, there are many, many license hydro projects that are coming up for relicensing in this time. There's a lot of relicensing going on, and I think we can all be assured that at the end of this decade, as a result of that, or a few years after it, there will have been a substantial change in how these resources are used for hydro generation in California.

Just to give you a sense of the river systems that will be affected and undergo comprehensive environmental review in this tenure period, I'm just going to name the rivers. I had a slide. It didn't project well, so I'll just name them. But think of this, the Pitt River, Hat Creek, Cal Creek, Butte Creek, Feather River, Bear River, Yuba River, American River, Mokelumne River, Stanislaus River, San Joaquin River, Kings River, Kern River, Eel River.

These are just PG&E's proceedings. And I think you can pretty much take all the rest of the major river systems in California and the rest of the relicensing will cover them as well. So our fundamental question for this panel is, are there opportunities to improve environmental quality while preserving hydro generation?

So I'm going to answer that question from my view. Generally, yes. That's the answer. Yes. That's it. I'm going to elaborate on that. Quite frankly, trying to improve environmental quality, while still preserving the other beneficial uses, including hydro and ration is the fundamental goal of relicensing.

I mean that's what's going on out there. That's what all the practitioners that are in this room are involved in. And I can say, and I'm sure my colleagues on the panel and others in the room will say, that that goal has been substantially achieved in PG&E's recent hydro relicensing proceedings.

I want to name three notable ones. They've already been mentioned her today. Rock Creek Cresta, Mokelumne and also the Battle Creek Salmon Restoration Project. Each of these three has been recognized by either state or national awards for environmental stewardship coming out of those relicensing proceedings.

And especially Mokelumne and Rock Creek Cresta have basically set the stage for most of the hydro relicensing going on in California now. However, improving environmental quality does come at a cost. And there's been some discussion of those cost. And I would say our experience on these five licenses are pretty consistent with the numbers that you've seen up there.

We're experiencing a range in terms of foregone generation anywhere from a couple percent up to around 13 percent. Same kind of range you saw out there. Maybe an average around five percent. It's important to recognize though when you think of these numbers, those are the numbers that came out of the ends of these proceedings, after all the balancing has been done.

I can stand here and say during the course of the proceedings we often see proposals for stream flows that would result in a 15 percent reduction generation, a 25 percent, a 30 percent maybe, a 50 percent, depending on type. So keep in mind these numbers, which appear to be modest, and I would say they are modest in the outcome, are not the numbers in the process.

I heard someone recently say relicensing is kind of like making sausage, something where the in process may be okay, but you don't want to see it done. I've been waiting to say that, and this was my chance. Okay. So those percent reductions look about right. And I would have to say they are modest.

The other thing, which hasn't specifically been addressed here is the cost of implementing those conditions that come out of new licensing.

On our five new licenses we've received in the last two and a half years, ignoring all of the routine license compliance cost that have come out of those, all the additional monitoring and reporting, but just the additional capital cost primarily for modified flow release facilities to make these much more environmental flows, and for recreational facilities, those five, we're looking at more than 60 million dollars in capital cost.

Those go directly to cost to production. Pam brought up the point earlier, yes, each increment may be small when they start adding up. That's the first five. We have 26 licenses. I just want to say there are costs. We think these are good trades on these proceedings. But there are costs both in terms of foregone generation and increase cost of production.

Going forward, we fully expect to find opportunities to improve environmental quality in each of the ongoing relicensing proceedings, and the upcoming proceedings. Our view is to focus, and we encourage others to focus, on the most significant resource issues, kind of go for the big ticket items, the ones that are the really important ones.

Ideally, to get the biggest bank for the buck, knowing sometimes it takes a big buck to get a big bang. And make sure that we understand what the tradeoffs are. And that's partly what this workshop is. What are the tradeoffs here? And there's been a lot of discussion, and we need to understand those.

We think the opportunities for improving environmental quality while preserving hydrogen are different for different projects for the reason that I've said. Each project is different. But PG&E is committed to continue to work with all the resource agencies, including the CEC, and earlier the ISO was here.

And the other stake holders, the other agencies, the other stake holders involved to make sure that these opportunities get identified and implemented as part of these relicensing proceedings.

One other thing I want to say before I go down, one of our handouts out here, I don't have slides for the presentation, is a new publication PG&E just put out within the last couple of months with the assistance of some of the other participants here today.

And it describes the hydro system, some of the issues pertaining to it. It has a list in here of all the community groups, governmental agencies, particularly participant proceedings. And on the back is a picture of the state, or a drawing of the state, that shows the locations of the project, lists the name of the 26 projects, the counties their located in, and the associated rivers.

So this is kind of a useful thing if you just want an overview of the PG&E hydro system. Thanks.

MR. MCKINNEY: Okay. Thank you, David. I think as Davis just demonstrated we're really fortunate for the end of the day here to really have national caliber participants, experts, and speakers. These gentlemen to my left have all participated nationally in numerous forum for FERK, for Congress. And I just really enjoy listening to them.

Our next speaker is Mr. Steve Wald from the California Hydropower Reform Coalition. Mr. Wald is director of the CHRC, which is an association of 25 river conservation and recreation organizations dedicated to the protection and restoration of California Rivers affected by hydropower dams.

Mr. Wald has coordinated CHRC member involvement in some 20 federal license and proceedings, and played a key role in highlighting threats to rivers posed by electricity restructuring and the subsequent power crisis. Prior to joining CHRC, Steve worked on hydropower issues for the Columbia Basis Fish and Wildlife Authority in Portland, Oregon.

Mr. Wald received his bachelor's degree in history and philosophy of science from Wesleyan University. Steve.

MR. WALD: Thanks.

MR. ALVARADO: That's not your slide either?

MR. WALD: Good afternoon. Congratulations, everyone, for making it this far through the day. I'd like to congratulate myself as well. In all seriousness, this has been an amazing day. I'd like to thank the Commissioners, and for the staff who have arranged this workshop on hydro.

It's an incredibly -- well, certainly for the organizations I've worked for, it's an incredibly important resource, one that sometimes gets overlooked when environmental impacts are considered, given the fact that hydro is as renewable and doesn't create emissions.

But we have some -- the folks that work for -- and CHRC by the way, not a household name, these are steering committee members of the CHRC. And as we said in the intro, it's river conservation and recreation organizations interested in hydropower projects and how they effect rivers, and interested in finding ways to reduce their environmental impact.

A lot has been said today. It's been really a comprehensive day. And some of what I have on my slides repeats some points. I will try to be more merciful and skip over and minimize repetition. At the same time, I might emphasize some point that are particularly important to our members when dealing with the hydro system.

And where I can, I'll try to find places to make specific recommendations to the Commission as it prepares its integrated energy policy report. So all day we've talked about the intersection really between our state's power system and its hydro system, and rivers.

And, you know, rivers provide a lot of benefits to Californians. Quality of life is a big thing here, as it is everywhere. And our rivers are a big part of that. The state's urban centers, as well as visitors from around the country and around the world gravitate to California in large part due to the incredible and natural resources we have here.

And the ability to live in this state's great cities, and play in its marvelous countryside is a big part of why people want to be here. So keeping those rivers in good shape is important to everyone, and important to the long-term outlook of the state.

And, again, you know, rivers provide an addition to our water and some of our power. It's fish and wildlife habit. It's a recreation resource. And those natural resources are also done in the (indiscernible), part of the economic resources of the local communities where the rivers are as well.

And so the main question we've all been asking here today is to what extent is the state's hydro system compatible with those uses? Can they coexist at the same time? And, you know, for the most part I'll say -- I'll be the first to admit nature is a pretty resilient thing, and they can coexist.

But I would also say that so this kid is smiling and has a fish, but I think he deserves better. I think all of our kids deserve better, and we can do better. And the good news is we are doing better over time in reducing the impacts of hydropower. To step back real quick and to just think of the basics of rivers before we talk about what hydro -- the effects of hydro on rivers.

You know, again, we've heard all day about snow fall and rain fall draining through the mountains, again, hydro harnesses that falling water to reduce power.

The rivers themselves, and the pattern and timing of the runoff, as well as the sediment carried through, and this slide emphasizes the sediment in particular, when that happens naturally and it's not impaired, it actually helps create habitat and create the functions that make rivers good places for fish and wildlife.

And, again, just emphasizing that the

very ability of flow and the movement of sediment through systems is what builds habitat, builds habitat complexity and diversity, and provides places for fish and plants, and wildlife to life, and to flourish.

Again, we've seen hydrographs. This is a representative of a natural hydrograph. And some of the components of it, including winter storms, a general snow melt peak that happens in the spring months, and a period of stable flows in the summer months. Again, each component of that natural hydrograph ended up playing a role for the river.

And altered hydrographs -- moving back towards the natural hydrograph plays a key role in reducing hydropower impacts. A quick slide just to look at the plumbing of the system. When you're driving by on a river you don't see all of the hydropower project at once. Rivers are flowing down hill through a cross section here.

You have reservoirs and diversion canals, pen stocks down to power houses, and more reservoirs. And what we have here is hydro system in California was generally engineered to capture, you know, 90 to 95 percent, in some cases 100 percent, of summer flow.

To, again, kind of stair step the bulk of the flow out of the river system, but to capture the falling water. And it's incredibly efficient at what it does. But it does result in stretches of river being bypassed and without water at all. This is kind of a hypothetical graph, hypothetical because we have a 20-year average of the Mokelumne River.

This is the average flow. Now, there is no average year, as we've seen on other slides. But this is contrasting what the regulated release at that dam on the Mokelumne River is, just to contrast what the average natural flow is versus what a regulated release can be.

This slide, it's actual flow date over several years. But what it does is actually capture the construction date of the Po Dam on the North Forth Feather River in 1958. And prior to the dam's construction, summer minimal flow. This is eurthymic scale of flow was right around 1,500 to 2,000 CFS in summer.

After the construction of the dam, the new regulated flow was 50 CFS. And it was 50 CFS every summer since 1958. That project is under relicensing now. This slide shows that extreme high flow events of course that exceed the diversion capacity of a project are still past.

But they're overlaid on a much lower base flow. And you're looking at a very different river system when the former minimum was 1,500 versus 50. Just some pictures of bypass reaches. And, again, kind of contrasting the scale to give you a sense of the size of the difference.

On the Pitt River there's currently 150 CFS in long stretches, the Pitt River, compared to a historic average of 2,000 in summer. Again, 19 foot capacity tunnel can hold 3,000 CFS. And then the North Fork Feather River we've seen this picture today several times.

Had a minimum of 50 prior to it being relicensed, historic average around 1,200. Now, on the receiving end of those diversions you have power houses. And although they sometimes are insulated from the river system itself by reservoirs, sometimes they're not. And power houses can spill right into river systems.

And the slide, if you can't see from there, it says from this to this in three seconds. The way that plays on out on a hydrograph is this is actually a different river, but it's showing stream flow cycling up and down a couple of times a day between 700 and 2,200 CFS.

And those ramping rates can be mere instantaneous. Stepping back in scale then from the individual project to a watershed, this is the North Fork Feather system again, and there's 50 river miles between Lake Almador at the top of the picture and Lake Oroville at the bottom.

Again, pretty efficiently engineered so the bulk of the flow moving through the system is kind of hopscotching outside of the riverbed. And so you have nearly 50 river miles that are either bypassed and substantially dewatered, or are inundated by reservoirs.

And stepping back in scale again, just to get a picture of California's 300 odd power houses, we have hydro on nearly every significant river in the state. And the level of impacts that we're talking about are not simply scattered about in a few projects, but are nearly almost every river, and long stretches of those rivers.

And that footprint, which is substantial, as we've heard today, produces 15 percent of the state's power, which raises the question of is, you know, the amount of megawatts we're getting out of the system in line with its environmental footprint.

The Energy Commission published an interesting report a couple of years ago. Part of it's biannual environmental report, which I believe has been superseded by the new integrated report. But that energy performance report, the environmental performance report kind of compared -- it took a first step actually in going beyond just looking at project emissions to try to include hydropower.

And I believe it was the first report that did that. And in an attempt to get in apples to apples comparison, looked at acres of habitat disrupted by different generation technologies. And it was interesting to note that by far the blue lines are acreage. And the methodology here actually just looked at the footprint of reservoirs themselves, the inundation footprint of a reservoir.

This is an easy proxy for disruption, although of course hydro projects disrupt linear river miles as well, just for starters, in addition to the roads and other infrastructure.

And then it compared megawatts to the acres and came up with kind of an efficiency of acre per megawatt.

And it actually shows hydro coming in here. When you read the fine print, the methodology just looked at PG&E's reservoirs, but took the megawatts from the entire state's hydro system. And it said if you actually matched PG&E's megawatts to PG&E's acreage, the number would be 11, which is above the top of this chart.

Again, I got pretty in-depth there, but just to highlight the fact that if you're looking at environmental efficiency you should look at the hydro system. This is a conceptual graph. And I want to say it's not to scale and it does not represent a policy of my organization and what the appropriate share of the pie ought to be between water for hydro and water for the environment.

But it does highlight that, you know, particularly on rivers where we're talking about 95 or up to 100 percent of water diverted out of channel, you're starting with a situation like this where most of the resource, and it's a public resource, is dedicated to producing power.

And we certainly feel that it's in the

public interest to look at where it's feasible to move towards a situation where you're getting multiple benefits from the public resource and you're able to share. And, indeed, that's the title of today's workshop is finding ways to have a viable hydropower system, but also improve the environment.

So what is this arrow? How do you move from here to here? If we zoom in on that arrow, in fact, it looks like this. It's the FERK relicensing process. And it takes five years. It happens only every 30 to 50 years. And as we've heard, it involves comprehensive studies. It involves now often times collaboration with various resource agencies and the public.

And when FERK issues those new licenses they're giving you equal consideration to power and nonpower uses of the resource. We would very much encourage the Energy Commission to become more involved in this process, although it's been acknowledged there's no direct jurisdiction over the process. The outcome certainly contributing to its record could contribute to, we think, better outcomes, more informed outcomes.

And in particular in the area where

we've seen today. We've seen there's been some progress today on modeling the energy implications of various scenarios. This is a quick map showing relicensing. License expirations across the state, and it's widespread.

These are some of the -- there's several areas right now where entire river basins are being relicensed at once, sometimes with multiple ownerships in the basin. But we're in the midst of a big wave of relicensing. And with that comes a lot of workload, but also a lot of opportunity for meaningful improvement in all of the problems we've heard outlined today.

Our organization's goals and relicensing include moving towards a restored hydrograph where it's feasible. A fish passage, fish passage opportunities where they're feasible, and improvements in fish and wildlife habitat, water quality, restoration of uplands and establishment of recreation where it's compatible with all of the above.

And of course, as David Moller pointed out, specific outcomes are going to be specific to each proceeding. And it requires studies to find out what's feasible. A couple quick slides on what it means to reconstruct a hydrograph. Going from that flatline we saw in an earlier slide moving towards the natural shape you look at things like this shows geomorphic thresholds.

Of course the higher the flow the more you're eroding and moving through the system in terms of gravel. And there are important thresholds that you need to achieve every year, or every few years to restore the natural function of a system. This is that same shape, but this time correlated to fish life history requirements.

And in this case an anadromous fish, as they play out their life cycle, all their fresh water life cycle in the river, that same shape serves important functions for the fish. When you now overlay that manufactured released coming out of a dam with tributary inflow, you're left with a composite hydrograph, which looks much more like a natural hydrograph.

And these have been -- some of the hydrographs developed for the Trinity River that scientifically are really kind of a state of the art on what we're trying to do in relicensing. So and is clear from this slide, and it's been talked about, when you're talking about reallocating water and potentially using water for different purposes, you are changing the amount of power available to go through power turbines, and there's going to be energy effects.

FERK has reported several times that the long-term average thus far with relicensing is there's about a 1.6 percent reduction in annual energy. I don't think many people think that average is going to apply in California. It's from projects mostly in the Northeast and Midwest.

Also, as we've heard, relicensing is changing. There's a couple of projects that have been relicensed recently. We'll look at Mokelumne and Rock Creek Crest. This is the Mokelumne River. Before the project was relicensed the minimum flow was the blue line at the bottom of the chart.

And the new license minimum flow is varied by water year. And as you can see, they look a lot more like the natural shape we've been talking about. PG&E and others have said that these new flows have virtually no net effect on project generation. There was, I believe, turbine upgrades associated with this. And the net is very close, maybe a small reduction.

On the North Fork Feather River, Rock Creek Cresta, again, changes in the minimum flow, the prelicensing flow are the lines closest to us. This project is being implemented over five-year periods. But over time, the flow's increased as shown. We had a modeler actually do one of these 25-year gaming models through different water year types.

And this shows average total flows through the system. The red is the remaining power house flows. The blue is water that's in the stream channel, which includes spill flows in the wet months. And the stripes are additional flows that five-year phase in flows, which you can see are quite significant in the summer months.

You know, accumulatively it may not make much of a difference in the winter months, but overall the power house is still being taken care of for the most part. And our model showed an average two to six percent reduction in annual energy depending on the water year type.

So this is the perspective from total energy. In terms of a project owner's perspective and, you know, we've had some of this data earlier today, so I'll go quickly, this just shows the cost comparative from nuclear and gas turbine. Hydro has by far the lowest cost.

And so presumably, could absorb some of its environmental (indiscernible) without overall losing its competitive nature with other generation technologies. And in terms of cost to consumers, this is just the generation component from a PG&E rate payer prospective showing the various categories.

Utility plants are the orange part of this bar, and it's about a penny of the total PG&E energy component of the bill. And that, I believe, combines PG&E's nuclear and hydro plants. The kind of energy losses are changes in relicensing are such a small incremental part of that orange bar, we would propose that it would be hard to find, although it exists.

It would be hard in the overall sense to appreciate an impact on the rate payer. And then lastly, this is real ballpark, and if anything this is just going to emphasize the fact that we need good modeling from the Energy Commissioner. But I did try to take a look at what a longer term impact of relicensing might be in terms of energy supply in California.

And I just looked at utility hydro and stepped it out through the year 2040, and said what if they lost ten times what FERK estimated, or three times what the numbers we've heard today? What if 16 percent was lost at relicensing? And it penciled out that by 2040 you would lose 580 megawatts.

I've seen in some of the documents today that, you know, we've built 1,500 megawatts of renewables in the last five years. This is a couple years old now, but it shows there was 10,000 megawatts of new power, either having been approved or under construction in California.

And just to compare the numbers, I don't know whether this number is still current. I suspect it's not. But five percent, the fact that it would take 30 or 40 years before you chipped away five percent of just like last years new construction, I think, is the kind of scale, the kind of perspective, that helps put some of the losses in relicensing in perspective.

And we would appreciate more insight from the Energy Commission in this area to help us make the decision. Because, and I'll end on this slide, you know, frankly, we don't want to have to make these choices if we don't need to. You've got to step back and look at the big picture.

Is it possible for these resources to coexist? We think it is. And we look forward to working with all the stake holders and the Commission to move towards that. Thank you very much.

MR. MCKINNEY: Thank you, Steve. The next speaker on this panel is Richard Roos-Collins. Mr. Roos-Collins is director of litigation of the Natural Heritage Institute, which is a public interest law firm based in Berkeley. Since 1991 he's represented public agency, nonprofit organizations, and natural resources, energy, hazardous waste, and air quality.

He was a trial attorney for CAL Trout in the Mono Lake cases. And he's the founding member steering committee -- he is a founding member of the steering committee Hydropower Reform Coalition. Here we go. Alaska Public Waters Coalition, chairman of the board of directors of Low Impact Hydropower Institute, the ag water management council, former chair of Friends of the River, former chair of Tuolommne River

Preservation Trust.

He's also coauthor of Rivers at Risk, the Concerned Citizens Guide to Hydropower. Before at NHI he was the attorney advisor, office of general counsel over US EPA, and deputy attorney general for the Public Rights Division, California Department of Justice.

He has a law degree from Harvard Law School, and a BA from Princeton. And welcome, Richard.

MR. ROOS-COLLINS: Thank you, Jim. Commissioners, thank you for this opportunity to make this presentation in this workshop. This panel was about opportunities to enhance environmental quality in relicensing consistent with reliable electricity supply. I have eight specific recommendations for your integrated energy policy report, which I will make once I have set them in context.

FERK has a duty to ensure that each project, and therefore each license, is best adapted to a comprehensive plan of development of the effected waters. That has been its duty since 1935 when the Federal Power Act was enacted.

The duty expressly requires it to

balance electricity generation with other beneficial uses protected by the law, including water supply, flood control, recreation, fish and wildlife protection.

Indeed, while we compliment FERK, and rightly, on the progress that it's made in recent years to improve the balance in its licensing decisions, in 1953 it actually denied a license for a project on the (indiscernible) and river near the Twin Cities because the project would have destroyed a waterfall, which was a critical aesthetic resource for those cities.

Now, how does the Commission get to a decision whether a license is best adapted to a comprehensive plan of development? It uses an open process. The applicant of course is a party. Any other person, meaning agency, corporation, association or individual with an interest in the outcome of the proceeding maybe become a party by filing a simple one-page motion.

The Commission must consider the evidence, as well as the briefs of all parties in a proceeding. And it's filed decision must be based on substantial evidence whether submitted by the licensed applicant or by other parties.

Now, when I say open process, I know that the federal and state agencies, which were represented in the room, may shudder a bit. For the past many decades the Federal Energy Commission has used its authority to preempt state law. It has succeeded in two Supreme Court cases, one involving this state, and innumerable court of appeals cases.

And yet, the Federal Power Act on its face expressly reserves for authorities of this state an effect mandates that the Commission -- that FERK respect that those reserved authorities. The first and most important is the State Water Board's authority to ensure that a license complies with all applicable water quality standards.

If it says no, the license stops. The second is ensure that -- to prevent interference with water rights. The third, to establish rates for retail services in the intrastate market. And fourth, to condemn a project if the state so desires on payment of fair market value.

In turn, federal agencies have nonpreempted authorities to establish fishway facilities, and also to protect federal reservations. When licensing creates truly extraordinary opportunities to enhance environmental quality, there is no grandfathering based on the original license.

The original license does not create a presumption that a license will be granted. And if it's granted, does not create a presumption what the license articles will be. FERK must make a new decision based on all applicable laws at the time of the relicensing proceeding.

I think that relicensing has resulted in four categories of enhancement that have been brought to your attention. And I will cover them hopefully in a way that it isn't repetitious. First, and most important, a new license tends to restore more natural hydrograph.

The licenses issued through the mid 1980s tended to require a minimum flow schedule that was anywhere from zero to 20 percent of the natural hydrograph. Meaning the licenses created artificial droughts in the bypass reaches between the dams and the power houses.

In relicensing in the past decade, FERK has tended to double or triple that minimum flow, tended to move the minimum flow above that threshold necessary for the sustained yield of the biological resources. Second, FERK now acknowledged its authority to issue a license based on the comprehensive settlement.

In other words, a settlement which is not limited to the issues within FERK's jurisdiction, but instead all issues that are in dispute between the applicant and other parties. The Rock Creek Crest and Mokelumne settlements, which David is rightly proud of, as we are, innovated what we call part A, part B.

Well, part A is proposed license articles, and part B is a contract that runs between the licensee and the other parties to resolve all those other issues. Thirdly, relicensing now tends to look downstream and upstream, tends to protect the watershed.

The Commission does not have jurisdiction to regulate the Army Corps of Engineers, or the Bureau of Reclamation, of that matter a local water supply facility. But it does have the authority to consider how the license project relates to those other facilities.

And in a few recent examples the Army Corps, and even the Bureau have actively participated in ensuring that a license project is operated in a manner that is coordinated with their own. Fourth, adaptive management. I will say at the outset, this term covers a multitude of sins, but there is an essence of good in it.

I understand it to mean essentially that a license is not fixed in concrete for the 30 to 50 year term prescribed by statute for the license. And instead, the licensee has permission, if it's structured properly, without FERKS further proceeding to modify the flow schedule or other measures to better protect the public interest during that licensed term.

In several recent examples, adaptive management has measurable objectives for biological resources, testable hypothesis for the impacts of the project operation on those measurable objective, systematic monitoring, whether the hypothesis prove out, and adaptation of the flow schedule and so forth if appropriate to make progress towards those objectives.

In short, I am bullish on hydropower regulation, given the substantial improvements in FERK's administration of the Federal Power Act, given the substantial improvement in the relationships between licensees and resource agencies, and also given the contributions of the resource agencies to the quality of FERK's licensing decisions.

I will say in passing that the hydro working group, which I believe you Chair, or at the very least help convene, has been very effective in assuring that the proceedings ongoing in this state produce quality results. And also in improving the general policies that apply to such proceedings.

Indeed, I think California may be among the best of the states in terms of its contributions to relicensing proceedings. Before I get to my recommendations, I also make one personal comment about Chairman Wood, who is in charge of FERK. My personal opinion, it's not CHRC policy. I believe he is the best chairman in the history of FERK in terms of his willingness to establish a balance between beneficial uses, and also in terms of his willingness to make hard decisions.

The HRC, including the CHRC, have gone before Chairman Wood on several occasions to ask for reforms that we thought were within his authority without rule making. These were reforms that we had been nagging FERK about for a decade. And Chairman Wood has already put them into effect.

Once he persuaded, they were in the public interest. And I think other stake holders, including licensees, have had similar experiences with him. I think this Energy Commission, and this Integrated Energy Policy Report has an opportunity to speak a chairman who might actually care about what you have to say.

So let me talk about the recommendations that I think, or I hope, will appear in your Integrated Energy Policy Report. I began by saying, Jim, you described the Energy Commission as an informational agency. And the first thing that came to my mind was news reports. And that's true of course. You do first rate analysis.

But you also have editorial authority, if you'll permit the metaphor. Indeed, the public resources code requires you to make recommendations, not just for your implementation, but also for implementation by other state agencies to protect our electricity supply, but also to enhance environmental quality.

One section of the public resources code even authorizes you to adopt standards for improved environmental performance. I think that the Energy Commission should contribute to innovation in hydropower operation, and also regulation. I respectfully disagree with the earlier panelist who described hydropower operation, at least, as a mature technology.

That may be true in terms of the actual blade that turns. But it's not true in terms of environmental performance. There are extraordinary opportunities to improve the environmental performance of existing dams. In fact, I'm reminded of a story that may help illustrate this point.

The first hydropower project in California was reportedly built in Bodie just north of Mono Lake around 1880. The engineer who built it believed that he had to run a straight powerline from the power plant to the mine, otherwise the electricity would jump off in space.

We laugh about that 120 years later. Yet, I guarantee you that in 25 years, maybe even less, what we take as state of the art will not be state of the art. This Energy Commission can contribute to that innovation.

So here are my recommendations: First, the state, including the Energy Commission, should enter into a memorandum of understanding with FERK that establishes the general procedures that will be followed in this state for licensing proceedings. Now, by and large, they're set in the rule, but there's flexibility in the rule.

For example, will the state agency participate in the drafting of the NEPA document? And MOU could spell out the procedures that we followed in this state so that we don't have repetition of the fights between FERK and the federal and state agencies that have so contributed to the troubled reputation of hydropower regulation.

Secondly, FERK is on the verge of adopting what it calls the integrated licensing process, which is designed to bring federal and state agencies into NEPA review on a more consistent basis. That rule is due out in July. If it is what the notice of proposed rule making described it to be, this state should actively support the ILP.

And, indeed, I believe that's what your

comments, your written comments did. I suggest more of the same. The rule, when adopted, will simply be paper. Administration of that rule is essential, and it is essential that FERK understand from day one that the State of California is committed to the successful implementation of that rule.

Thirdly, in an appropriate circumstance, the state, possibly including the Energy Commission, should use an authority granted by the Federal Power Act to request a joint proceeding with FERK. For example, you share jurisdiction over certain aspects of the energy market, and also rates.

To my knowledge, you have never asked for such a joint proceeding to occur. Rather than have our proceeding here, and their proceeding there, what about a joint proceeding before the federal and the state Commissioners to ensure that we get it resolved, that works at both ends of federalism.

Leaving aside procedures, let me talk briefly about science. This is my fourth recommendation. The state, including the Energy Commission, should compile and maintain a public data base that shows all results of the environmental impacts of hydropower projects.

This has never been done at any state. It is certainly not being done here. Margin results are compiled project by project. They are generally maintained, and rightly, by the licensee. And yet they have accumulative impact that is regional. And that regional impact can only be understood if there is a comprehensive date base.

Fifth, the Commission, as well as other state agencies, should consider the possibility of establishing a real time monitoring network for water quality impacts that are otherwise not addressed in the monitoring articles in licenses themselves. Again, with an exception or two, there is no license in this state that requires monitoring of the temperature, or dissolved oxygen concentration at a point of control at a licensed project.

And while we may have to wait until relicensing to make that a mandate, there is absolutely nothing standing in our way actually establishing a comprehensive monitoring network. And indeed that could be done relatively inexpensively. Let me turn finally to results.

My fifth recommendation is that the state adopt as formal policy that a new license should be based on a comprehensive settlement, assuming that the state agencies concur that it complies applicable laws. And the comprehensive settlement should include adaptive management in the rigorous form that I was describing earlier.

Sixth, the Energy Commission should cooperate with the US Department of Energy in the further development of hydropower technology. Let me give some examples. Today, to my knowledge, there is no fish ladder in this country that effectively gets fish more than 50 feet in height. Is that right, David? I don't know of any. Is that the limit? I don't know.

Most of the dams that were on Steve's screen have more than 50 feet of height. Does that mean that fish passage is impossible short of truck and trap -- trap and truck, excuse me. Where we actually have the fish netted and then put in trucks and trapped upstream.

We ought to explore whether we can do better than that. Or coming downstream, there are substantial opportunities to improve the performance of turbines so that fewer fish are killed or injured in the course of passage with turbines.

And finally, the Energy Commission should continue on its current course and encourage the Public Utilities Commission to adopt rates that were (inaudible) performance. You currently are involved in a proceeding regarding public resource code section 454.3 that allows a bump up in the rate of return for such performance.

We support that. We encourage more of that. Thank you very much.

MR. MCKINNEY: I hesitate to open the door for questions, but this has been an extremely interesting and thought provoking panel. So I at least want to provide the opportunity for Chairman Keese and Commissioner Boyd to pose any questions that they might have for the panel.

And I want to make one minor correction on something that you said, Richard. Commissioner Boyd was the Chair of the hydro working group. And I was just the foot soldier who kept the pieces together.

PRESIDING MEMBER BOYD: But you

inherited it.

MR. ROOS-COLLINS: My congratulations to you for your good work.

PRESIDING MEMBER BOYD: I don't have any questions. Actually, I'm fascinated. I appreciate the panel. And I will say you answered about four questions that I had on my agenda that I believe is pretty fully answered here. So I'll pass on.

MR. MCKINNEY: Great. Thanks again. Let's see. I'd like to have our final set of panels and speakers come forward. We are going to have Mark Anderson from the Department of Water Resources, Lon House, who's representing the Association of California Water Agencies and Regional Council of Rural Counties, and then Steven Rothert with the American Rivers.

The first speaker on our final panel will be Mr. Mark Anderson from the Department of Water Resources. And I am chagrin to admit that he sent me his bio and I have misplaced it. So I'm about to ask him to say what he would like to say about his background and experience.

MR. ANDERSON: Thank you, Jim. He probably misplaced it because it was so short.

I'm a relative newcomer and neophyte to relicensing activities for the department. I've been with DWR for 12 years working primarily in operations and maintenance of the State Water Project and flood control projects connected to the State Water Project.

And prior to coming to the department, I worked in the oil and gas industry as a reservoir engineer for about ten years, focused on primarily economics of drawing ventures and so forth. I'm a graduate of Cal State University Sacramento with a degree in interdisciplinary degree and civil mechanical engineering, and a licensed civil professional engineer in California.

I'd like to first of all, on behalf of DWR, thank the Energy Commission and the Commissioners for the opportunity to participate here today. And I would also like to mention that also from the department here in the audience today is Curtis Creal. Curtis is one of DWR's top operations gurus.

And he helps keep the water project running. And also, the department's program manager for all of the Oroville relicensing activities, and that's Rick Ramirez.

I'd like to start, this might seem a bit odd, but with the mission statement for DWR today. And as you can see it's to manage the water resources of California in cooperation with other agencies to benefit the state's people, and to protect, restore, and enhance the natural and human environments.

And the reason I'm sharing this with you is because this mission statement is what makes DWR somewhat unique as a FERK licensee. That is we're a state resources agency with a licensed facility. So we have broader state mandates than say an investor on a utility might have that is only operating that facility and then looking to their shareholders.

Some of those responsibilities include water supply and planning responsibilities in California. It also includes dam safety regulation, significant hydroelectric project responsibilities, and extensive energy supply responsibilities as well. I also wanted to give you snapshot of the Oroville Facilities and how they fit overall into the State Water Project.

And here on the Feather River watershed is where the Oroville Facilities are located. The

Oroville Facilities built the State Water Project as a whole, provides water for about two-thirds of the state's population, and irrigation water for millions of acres of agriculture as well.

The Oroville Facilities are the primary storage facility reservoir for the State Water Project. And lastly, in our normal operation we don't, quote, unquote, lose water to generate energy. And what that means is we generate power when we release water for a variety of project purposes that I'll get into here in a second.

A couple other points about the Oroville Facilities, big picture I'd like to make, they are the key -- the Oroville Facilities generation is a key component of the State Water Project, which is the fourth largest energy producer in the state.

And this helps keep the water prices low for the consumers who use State Water Project water. The State Water Project is also the single largest consumer of power in the state as a whole. And about two-thirds of the power generated at Oroville -- about two-thirds of the overall State Water Project power needs can be generated at Oroville.

Also, the Oroville Facilities provided a vital resource providing ancillary benefits. We have a map here. This is a map of the Oroville Facilities showing the FERK project boundary. That's the red line encompassing the reservoir here, down the Feather River to the (indiscernible) afterbay, or forebay and afterbay. And then farther down the Feather River.

There's another project that Oroville Facilities map, and it just essentially more of a closeup showing the Oroville Dam here with the high power plant. Six units there, capable of generating 644 megawatts rated capacity. Three of those can be run in reverse to pump back into the reservoir.

We have a three megawatt generator here at the Thermalino Diversion Dam, the power canal then leads to the Thermalino forebay, and the Thermalino pump generating plant, which has I believe four units there, three of which can pump back as well. And then Thermalino afterbay, which helps us regulate the pump back operations and flow into the Feather River.

In addition, on this graphic you can see the pump back profile for the facilities. I would like to touch, again, a little bit about the operational strategy at the Oroville Facilities as the key water supply reservoir for the State Water Project.

Again, the objective in our operations there is to maximize the water supply benefits. And what I mean by that is the benefit for all the uses of the water released from Oroville. And that's also subject to a number of constraints where regulatory constraints have include the flood control criteria that the reservoir must be operated to pursuant to the Corps of Engineers guidelines.

We have Bay Delta criteria for flow and water quality. We have other environmental constraints in stream flow and temperature for fish and wildlife, and habitat purposes. And there are other physical and operational constraints on the system.

What's important about this is after all of these objectives, guidelines, sort of flow chart have been met, then we generate power as a result of operating for these other objectives. So, again, just to recap quickly, these are some of the reasons, the primary reasons, why water is released from Lake Oroville.

We need local water supply demands. And this speaks to primarily what we call the Feather River service area contractors. And these are folks that have water rights on the Feather River prior to Oroville Dam being constructed. We have an in stream flow requirements that I talked about for fish and wildlife purposes.

We also have the Bay Delta criteria here that speak to flow in the delta and water quality, (indiscernible) standards in the delta. We have the flood control criteria we have to operate to. And then lastly here, our effort to optimize out ability to meet annual State Water Project supply.

I just have a couple of graphics that kind of illustrates some of these criteria. This is the flood control reservation diagram for Oroville, for Lake Oroville. The line at the top is the reservoir capacity, the red line. And then the blue line, the two blue lines, are the encroachment limits depending on the upper line is where a dryer watershed dryer conditions.

And then the lower one is for weather condition. And you can see then just for a few months during the summer there's no flood control reservation at all. This graphic sort of illustrates some of those in stream flow requirements I referenced. We have flow cubic feet per second on the left.

And the months of the year on the bottom. When this says average and low in flow, what we're talking about is in flow to Lake Oroville. And the low storage is also referring to the storage condition of Lake Oroville. So you can see the lowest in stream flow releases are when we have a low storage condition in Lake Oroville somewhere around 900 CFS here during the winter.

Decreasing to maybe 750 CFS during the warmer months. And then also with the average in flow condition, higher released in the winter. And pretty much similar to the low flow conditions during the summer. Now, this is a very busy chart, or graph, whatever you want to call it.

What I'm trying to illustrate here, this speaks to some of the Bay Delta standards pursuant to D1641 that stipulate how a department must operate and release water from the Oroville Facilities. And these standards really cover two areas here. We're talking about fish and wildlife that is flow based.

So all of the ones in this area of the chart are designed to protect various fish and wildlife with a stipulated flow release for the time of year. Now, each of these also has a footnote that further expands or complicates how that's employed. We also have water quality standards for the delta, for municipal and industrial use, agricultural use, and for fish and wildlife.

So collectively all of these things significantly influence and impact how and why the department releases water from Lake Oroville. The next series of graphics, I have a couple of pie charts, several actually, that depict the actual releases for several categories in specific years.

So this is the year 2000, and what this shows is four categories of water being released from Oroville. The magenta colored slice of the pie, which is about 38 percent, represents the downstream requirements and the in stream flow requirements. This cross hatch pattern here at the bottom is about 23 percent of the total water released that year.

And these reflect control releases. Again, the Feather River service area contractors

I had talked about earlier, 23 percent here, and then exports specifically to support the State Water Project, 17 percent. This pie chart represents calendar 2001. And a big difference between this and the previous one, the flood control releases here are zero.

The in stream and delta requirements represent half of the total releases. The Feather River service area releases represent 46 percent, and then only four percent to support State Water Project exports. The last calendar year we're looking at here is 2002. Again, it's roughly one-third proportion here.

In stream and delta requirements, 38 percent. Feather River service area, 34 percent, and the State Water exports 28 percent, zero for flood control. I would like to note that none of these water years -- the total volume of the pie will vary from year to year obviously based on the hydrology occurring, and the precipitation in the Feather River watershed.

This shows the total power generated at the Oroville Facilities over the period 1979 through 2001. And on the Y X's here we have total power produced in gigawatt hours starting with --

on the X's we have starting in '79, and it going up to 2001. The different colors represent the different types of hydrologic water years.

So the blue color here represents wet. And I think the red is critical, and the magenta, or purple, is dry. So a no brainer here. Obviously we make a lot more power during the wetter years than we do in the dryer years. But, again, it does show a pretty good variation from year to year.

This slide is another depiction of the power generated at Oroville. This is the percentage of total power generated from our pump back operations. The Y axis on the left varies from zero to 20 percent. And, again, the same year timeframe, '79 to 2001. The water year types are also labeled on here with the below normal, above normal, dry, wet, critical, so forth.

And, again, the water year type has a major impact on the percentage of total power generated at Oroville be it pump back operations. But what I'd like to point out about this graphic is that if you looked -- while this percentage here maybe 14 percent, the total power generated from pump back operations is probably fairly consistent in terms of total megawatt or gigawatt hours.

It's that the total power generation for the Oroville Facilities is much lower in these dry critical years. That pretty much wraps up all my slides. Again, after following some of these very distinguished and experienced relicensing folks, I feel a little ill equipped today.

But I would like to say that in terms of the purpose our invitation here today to address the balance, if you will, between developmental and nondevelopmental resources in a relicensing proceeding, what I was trying to demonstrate with the slides is that there are many constraints already in place for DWR to balance these developmental and nondevelopmental resources.

And what we're hoping is, in our current licensing proceeding at Oroville under the alternative licensing process, that our 71 study plans that we now have underway will help us, enable us, to do this even more effectively into the future and in the terms of the new license. Thank you very much.

MR. MCKINNEY: Thanks very much, Mark. Our next speaker is Dr. Lon House. Dr. House has a bachelor's, two Masters and doctorate in engineering and economics from UC Davis. He also has a certified energy manager's certificate. He's taught engineering at the graduate school at UC Davis for many years.

And he worked here at the Commission for five years as a utility planner. And then was the chief utility planner for the CPUC for five years. In 1990 he went out into the consulting business starting his own firm, Water and Energy Consulting.

He's been an association of California Water Agencies, which is ACWA, energy consultant since '92, and represents 500 water agencies. He also represents the Regional Council of Rural Counties, known as RCRC, as their energy advisor since 1999. And RCRC includes 29 rural counties.

I actually don't know Dr. House very well. I know his name very well. It comes up all the time. And when people ask me questions about hydro, small hydro, I find myself often giving out his name and phone number and say, you know, talk to an expert on these things. So, Dr. House.

MR. HOUSE: I'll try and live up to that billing. I'm going to give you a bit of a background that I think has been lacking today, just to kind of give you a perspective on the world that we're dealing with here. About 75 percent of the rainfall, I'm using rainfall as precipitation, occurs north of Sacramento.

About 80 percent of the water occurs south of Sacramento. We're Mediterranean climate. So 80 percent of our precipitation occurs from November through March. And actually, most of it occurs in three months, January, February and March.

Now, about 70 percent of our consumptive water use occurs from May through October, which means that it occurs after the precipitation has already come down. So what does that mean? That means that the precipitation that comes down in the winter time has got to be stored someplace, and stored in many of the reservoirs that particularly my members are going to be talking about.

And then I just put at the bottom here this is -- we have about 71,000 acre-feet of water per year as runoff. And I'm going to be talking primarily about the consumptive use, which agricultural and industrial and urban. But you can see that the majority of the water that comes down in the state goes to nonconsumptive uses.

Okay. I want to just give you kind of an overview, real quick overview. Some of the people have already talked about this. About what the water is associated with in the state. The water in the state is owned by the state. And the ability to use that water is granted to the state.

And that has actually been administered by the State Water Resources Control Board. And then I just bring up down here the 1914 Water Rights Commission Act. And you'll hear in some of these discussions if you deal with water, pre 1914 rights. And pre 1914 rights are rights before the Water Commission Act.

And they're very, very strong, very, very powerful rights. I put this up to talk about most of the water rights that we're talking about here are nonconsumptive rights. Almost all of the hydropower rights, with a couple of exceptions, are nonconsumptive rights. That means the water doesn't leave the basin.

It stays within the basin. And it's not being used up. And I just want to talk about that there's the Pueblo Rights, there's the Riparian

Rights, Approbative Rights, Federal Reserve Rights, which mostly deal with federal agencies, and the Public Trust Rights.

The point I wanted to make here is that the system is very precariously balanced right now based upon all of these conflicting rights. Because there's virtually no water in California that somebody doesn't have a claim on. And when you start going in and shifting water among periods for some other reasons, you're going to start running into water rights problems.

And we haven't really seen that thus far. But I predict that we're going to see that more and more of a problem as the new FERK relicensing. Area of origin laws, area of origin is something that has not been very well utilized in the state.

But basically what the area of original law say is that if you -- it allows the area of origin, which is where the county, where the precipitation comes down, to come back sometime way in the future and say we get bumped up in the approbative right schedule.

Basically what it says is when most of these dams, and some of these things start going in, the area of origins, which are Alpine County and some the mountain counties, they said we don't have any water -- we don't have any use for the water right now.

But we are not going to agree to have you build Oroville, unless you give us the ability to sometime in the future, when we have a water right, when we have water to be used in our area, to be able to come in an get ourselves bumped in the priority system.

The reason I'm bringing this up is, up until now this has very, very rarely been used. But as the rural counties start to develop, what you're going to see is you're going to see some challenges to the use of water under (indiscernible) rights, which says Placer County for example saying we're starting to develop.

We have the use for this water right now. You guys have been doing this for 50 years. Now we're going to come in and we're going to use the water, and you have to give the water to us. And so it's something that's going to disrupt the balance of, and the allocation of water.

You've seen this map before, but the hydroelectric projects down in the Los Angeles area, just little dinky ones, but where are the hydroelectric projects? They're up where the hydro falls, where the precipitation falls. And you can sort of divide into two groups.

One is the very good hydroelectric projects with the ones that are high in the mountains with a real steep grade. And the other one that you can deal with, which is what I'm going to talk about, are the storage reservoirs, the big water storage reservoirs are low level reservoirs, generally from 1,000 to 3,000 foot elevation.

They're the big ones that you think about, Comanche, Pardee, Oroville. They're the ones that we get our water from, the water that we're using in the state. And I just wanted to -- this is in your book, or your handouts, I just want to show this to you. This just shows you the river, what agencies have, what water agencies are operating on and have hydroelectric facilities on that river, what utility generations on that river, what the normal runoff is on an average year.

But look at that dry runoff. When you end up with a dry year, you can end up with some of these watersheds that end up with ten to 15 percent of the normal runoff, which means they just don't have any water at all. And one of the things we're seeing in a lot of the hydro relicensing is you're getting two or three different hydro years that you have to respond to.

You're getting wet, average and dry. And on some of these, particularly you look at some of it like the American and some of the Feather, on the dry year you just simply don't have any water in the system. All right. The next couple of pages are just a raft of (indiscernible).

And what I've done is I've allocated them by rivers. So you can see what they are, who's showing up, and on what river. Now, the demands for water in California, you can see electricity production, endangered fish, Bay Delta and consumptive use of water.

So I'll just go through these. This is just a list. You guys have seen that. It's not included in amphibians and the beetles and stuff like that. This is a point. This is where we are now starting to run into more and more trouble. These lower level reservoirs, which are the big storage reservoirs, they have a lot of volume, but they're at the lower elevations.

And they're very broad and they're very flat, which means they heat up in the summer time. They also block the passage of the anadromous fish to the upper levels. And so we get the spawning that occurs below these lower level dams. The problem is that those fish are used to spawning in very, very cold temperatures.

So what we've got, and you can see what's going on at Shasta and some of the other big lower level dams, is you get these temperature control devices that are trying to release colder water so that the fish would normally would spawn in say 7,000 foot elevation or so are now spawning down below that dam.

And you look at these temperatures right here, and this is just an example from I believe this is from the Mokelumne. But look at some of the temperatures. This is the presence of the river and the life cycle, and the temperatures. We're talking 40 to 50 degrees.

Here's where we run into the problem. If you start increasing minimum flows on the upper level, hydroelectric facilities, that means that we do not have enough cold water coming down in August and September and October to meet these temperature requirements in the lower level reservoirs, because remember the lower level reservoirs are broad.

They warm up. And they're dependent upon cold water coming in during the late fall from the upper parts of the river. If you use that cold water up with increase flows, you cannot meet the temperature requirements, and you end up really devastating the fish population below the lower level dams.

This is just -- there's a gentleman from the our Water Resources. The only reason I had this up here is this is the last one. I wanted to bring up a couple of points. One, look at the shortages. And the shortages are going to be even higher, at least on the Department of Water Resources.

The new one that's coming out that will be officially released, the final will be released next year. We're 1.6 million acre-feet short of water on an average year, and 5.1 million acre-feet short of water on a drought year. And based upon Bolton 160, the '98 version.

The reason you haven't seen this is because we've had ten years of above normal precipitation. We go back to a normal cycle with droughts and you're going to start seeing 1.6 million or two million acre-feet of water a year, which we can't supply. Okay. Summary, it's a delicate balance when you go in and you start shifting water among seasons.

You start running into water rights problems, water rights issues. There's a host of overlapping water rights. Climate change, we've talked about it a little today. This is something that is really disturbing a lot of the water agencies because remember the precipitation occurs basically in three months of the year, January, February and March.

Our water use is from May through October. That water is either stored either in reservoirs or stored as snow and it melts. And one of the things that the Association of California Water Agency has done a lot of work on, if the climate change results in the precipitation coming down as rain and not as snow, we cannot meet water requirements in the State of California without more surface water storage.

There simply isn't enough storage. If it's not stored as snow in the snow banks, and melted down through the summer time, and it comes down and it rushes down the rivers, we don't have enough storage to get through the year. I've talked about the increase in stream flows, deplete the cold water, and limit our ability to keep the fish health below the lower dams.

And the (indiscernible) and water rights haven't been widely exercised up to now. But as the rural counties develop, you're going to start to see this become a problem more and more. Thank you.

MR. MCKINNEY: Okay. Thanks very much, Lon. The last speaker on this panel, final speaker for the day, is Steve Rothert. He's the associate director of the Dams Program for American Rivers, and works out of American River's field office in Nevada City.

Steve was the first coordinator for the National Hydropower Reform Coalition while working for American Rivers in Washington, DC in the mid 1990s. Steven's current position involves equal shares of hydropower relicensing and dam removal work in Northern California and Southern Oregon.

Steve.

MR. ROTHERT: Thanks for the introduction, Jim. And thank you, Commissioners, for this opportunity to speak with you. And thank you all for sticking with us through the very end of this, this interesting workshop today. I welcome the challenge of being the last presenter because it gives me the opportunity to have the last word.

What I would like to do for you today is to offer the Klamath River as an example, a case study of the challenge of balancing public interest, public benefits that rivers offer. And offer it up as an example of a river that I would argue is very far out of balance.

And we have a great opportunity through the relicensing and other activities in the basin to try to restore some of the balance to the river. So as you can see, the Klamath River Basin is in Southern Oregon and Northern California.

The upper basin is around the Upper Klamath Lake. It's a very dry area, receives 12 inches of precipitation or less per year, but gets most of its runoff from the eastern slop of the cascades. You can see there around Crater Lake.

The hydropower project that Jim mentioned earlier, and others have mentioned, begins below Klamath Falls and includes five main stem dams that begin in California and end in -- I mean begin in Oregon, excuse me, and end in California where the river is flowing through the rugged Klamath Mountains and out to the ocean.

This is just a closer view of the project. Here's Upper Klamath Lake, Klamath Falls, Keno Dam, which is not a hydropower dam, the JC Boyle Dam. We have the Copco 1 and 2 Dam, and the Irongate Dam, which is the lower most dam. Two images typify or best exemplify the upper basin.

One, is an image such as this of the incredible numbers of migratory water fowl that each year visit the Klamath Basin as an important stop on the Pacific Flyway. And you can see the snow geese here. This is Tule Lake National Wildlife Refuge. One of the, I believe, six refuges in the basin with Mt. Shasta in the background.

The other imagine that typifies the upper basin is irrigated agriculture. The Bureau of Reclamation has a project that covers 200,000 square feet -- I mean 200,000 square acres. And private interest have another 150 to 175,000 acres in the basin. And in the summer up to half of the water is diverted for agricultural use.

This is a typical view of the middle and lower Klamath River that's popular among boater, anglers, campers and lots of other folks with interest in rivers. This is another shot of a campground there that's very popular in the summer time. The Klamath River used to support, as I believe Jim said earlier, the third largest Salmon run on the west coast.

And which was an important resource for many interests on the river, including the Native American Tribes up and down the river. The Klamath Tribes used to be among the only tribes in the nation that were totally self-reliant on their reservations needing no assistance from the federal government, and fish, salmon, and other fish were a crucially important resource that sustained both the health and the economy of their communities.

It was also, and continues to be, an important cultural resource. And really the center piece of a lot of the philosophies and beliefs of the Klamath Tribes. And with the (indiscernible) of the fishery and other degradation of the river, it's caused severe problems for the tribe.

It's not uncommon for Klamath Tribe to experience poverty and unemployment rates exceeding 75 percent. Of course it's not just the collapse of the fishery that contributes to that. But it's an important contributing factor. When White settlers first arrived in the basin, they used to complain that their horses would be reluctant to cross certain streams because the fish were so numerous and so large.

These are some folks who had caught some, I believe, steelhead around the turn of the century, or the previous century that is. More recently, the Klamath River used to support a healthy salmon fishery in Northern California and Southern Oregon. Klamath salmon accounted for between 20 and 50 percent of the catch in fishing fleets from Fort Bragg all the way up to Coos Bay Oregon.

Today, with the collapse of the fishery, the harvest is extremely limited, and the fishery, the commercial fishery, has largely collapsed causing the loss of thousands of jobs, and up to approximately 100 million dollars a year in income. I think that the best, or perhaps the most dramatic image that would indicate the health of the fishery is the salmon kill that occurred in September of 2002 when we lost more than 33,000 adult salmon that were on their way back to spawn in the river.

And of course the hydro project is only one of the contributing factors to the decline of the river. And in the California Department of Fish and Game concluded a study of this fish kill that low flows and water quality were the primary cause. But it's clear that the hydro project stands in the way of recovery of the salmon runs, and of restoration of full health of the Klamath River.

So I'm just going to show you a couple of slides of the projects. We'll start here with John C. Boyle and work down to Irongate Dam. And these four projects are the -- their the projects that produce the vast majority of the power in the system. And as we have said before, we're going through relicensing.

The license will expire in 2006. And

the restoration of the salmon fishery has become the most important and the most controversial natural resource issue in the relicensing. And the vision for hydropower in the basin came from this gentleman, John C. Boyle, who, with his team of young engineers, constructed the first dams in the system.

And was honored with the naming of the John C. Boyle, or the J.C. Boyle, Dam after him, which was the upper most dam. This is the bypass reach in the J.C. Boyle, below the J.C. Boyle Dam. And the J.C. Boyle Dam represents about 50 percent of the production of the project. This it the next downstream project, Copco 1.

And the reservoir of Copco 1, which is this inundated several miles of habitat. And you can see in the next picture, if you just keep your eye on this cliff here and these trees, you can see that the reservoir flooded quite a large valley, and many miles of river meandering through the valley, and good fish habitat.

This is the next downstream project, Copco 2, which is a diversion project, again, and has a bypass reach of three or four miles associated with it. The lower most dam, Irongate

Dam, is the dam that blocks salmon from reaching their historic habitat.

They have constructed a fish hatchery, which maintains the fall chinook run, but several of the other runs have essentially been lost in the river. And we've started to look at what habitat is available. This is a map that was prepared by Noah Fisheries and shows the extent of the habitat that we believe salmon, chinook, and steelhead, and in the lower reaches, coho salmon used to reach.

And although many miles of the habitat upstream of the dams, and upstream of Upper Klamath Lake have been affected by agricultural development and the associated water quality problems, there is believed to be still more than 100 miles of habitat that would today support salmon and steelhead runs if they could only get there.

And this is talking about balance and the use of rivers, and who benefits. The two main individual beneficiaries of the Klamath River is agricultural industry in the upper basin, which has been estimated to be worth less than 200 million dollars. And the hydropower project that

Pacific Corps owns, that out estimates put at less than 25 million dollar per year.

And the USGS completed a study in 2002 that tried to estimate the value of a restored river and put it at above, well above, two billion dollars per year. And I know there are issues with the methodology of this study, and someone questioned some of the assumptions, but the point remains that it seems rather clear that the balance -- that there is a lot of good balance of public benefits and the distribution of public benefits, and public interest on this river.

And we are hoping through the relicensing to restore some of that balance. And I guess the question that you're most interested in as Commissioners of the Energy Commission is how the Energy Commission can play a role, and what does this mean for the Commission?

And I think that as Richard Roos-Collins and others said earlier, FERK has, as part of its mission, to the task of trying to determine what the public interest is in the relicensing proceeding, and how best to manage the river. And frankly, in our view they don't do a good job at looking at the big picture and trying to place the project in the context in which it belongs.

That is that the context of all of the interest that share or should share, or could share in the benefits of the river, and not just the licensee and the most direct beneficiary.

So the Commission can help in providing analysis and information to put projects in the context of the grid, and power supply, and power reliability so that stake holders, including FERK and the agencies, can better understand how the project fits into the broader definition and calculus of the public interest. Thanks.

MR. MCKINNEY: Thank you, again, Steve. My thanks again for Lon and Mark for sticking it out here. Let me wrap this up pretty quickly because I imagine you're probably as tired and as hungry and I might be. The purpose of this workshop under the Integrated Interview Policy Report, legislation and our current program with that is to identify major trends and issues around issues of supply demand pricing, reliability and efficiency.

And then the impacts on the economy, resources and the environment. So what we really tried to do here today is let the rest of the world know what the Energy Commission understands and is doing in some of these areas. And also to inform ourselves, both our Commissioners, our advisors, managers, and Energy Commission staff on what the complexities that some of these issues are.

I'm not quite sure how we're going to pull all this together to white paper, because that's going to be a lot of work. But I do want to acknowledge that the incredible diversity and complexity of the issues involved here. And, again, thank all the people that worked to prepare presentations, and spent their time today helping to inform us what their view of the world is.

And I also very much appreciate the recommendations the numerous stake holders have made on how the Commission might exercise some its knowledge and capacity, and perhaps authorities in the hydro arena. With that, I'd like to provide one last opportunity for our Commissioners if you have any closing thoughts or comments.

PRESIDING MEMBER BOYD: One comment, or a couple comments, as Chairman of the Integrated Energy Policy Report Committee, I want to thank the staff for arranging this seminar today. I called it a seminar rather than a workshop only because it was highly educational. And in workshops there's usually more contention.

And there's not such polite introductions. And there's never applause. So obviously this was a seminar. I want to thank the audience for toughing it out this long. This has been very educational. A lot of issues have been put on the table. And, yes, you staff, and we will have to digest all of this to sort out the issues that need to be acknowledged in a report, such as the Integrated Energy Policy Report.

And just see what other issues that we as an agency feel we can and should pursue without benefit of perhaps of needing to include in such a report to the Governor and legislature. Anyway, I want to thank everybody. It was extremely, extremely interesting.

Chairman Keese, anything?

CHAIRMAN KEESE: I want to thank everybody, too, except for the one thing that I looked and I said Oroville? They can't be relicensing Oroville. I was there as a young adult before they put water in it, which my fellow Commissioner tells me he was also.

PRESIDING MEMBER BOYD: I was there the day they poured the core block.

CHAIRMAN KEESE: I do appreciate everything. I live on Feather River. I've lived on the Feather River for the last 20 years. So I do appreciate the education and a lot of aspects of the Feather River I didn't understand before. And I guess we did hear six specific suggestions for things we might have in this report from one individual.

They clearly will be considered. I would urge any of you who believe there's a specific plank that we should have in our platform to feel free to send it to us and it will be considered.

PRESIDING MEMBER BOYD: Thank you all.

MR. MCKINNEY: And one last thing, I want to acknowledge the work of Mary Dias who's the assistant project manager in my unit for the incredible support work that she's provided to help make this all happen. Obviously this was a team effort, and I want to acknowledge her.

So, again, thanks very much for all the participants. And I would ask that I think it was David Moller and Richard Roos-Collins did not have powerpoint presentations, which was a nice break. But whatever written remarks you have that we could put on the record would be appreciated.

(Thereupon, at 5:47 p.m., the Committee Conference was adjourned.)

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CERTIFICATE OF REPORTER

I, ALAN MEADE, an Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission Committee Conference; that it was thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said meeting, nor in any way interested in outcome of said meeting.

IN WITNESS WHEREOF, I have hereunto set my hand this 16th day of June, 2003.

ALAN MEADE